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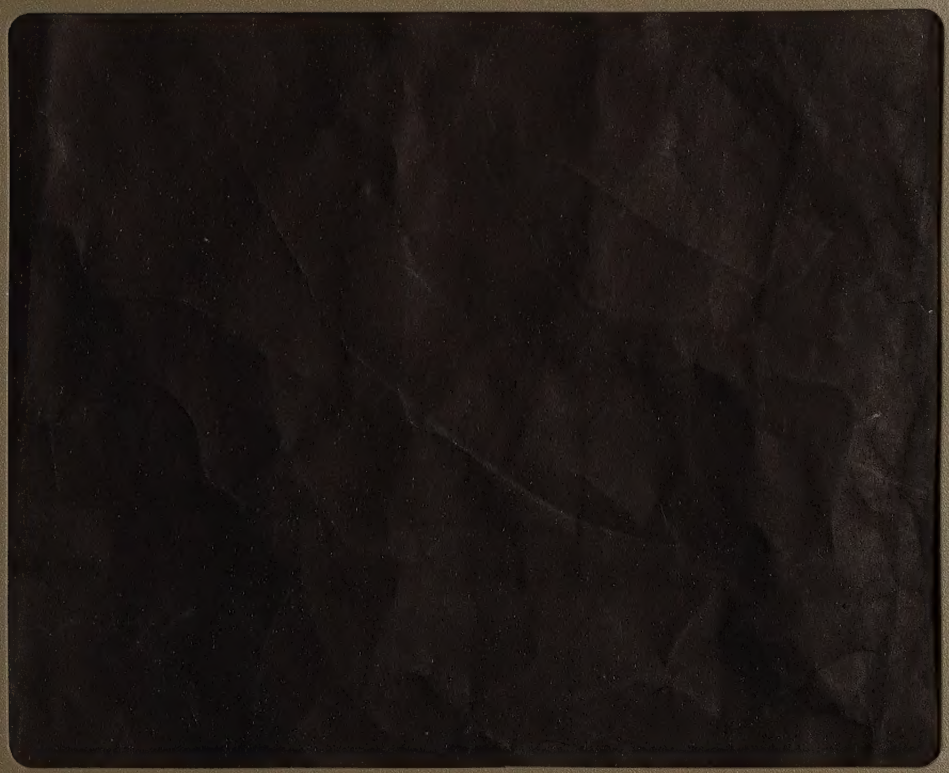

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NOTE

This manual documents the Model 7261A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

7261A
Universal Counter/Timer

Instruction Manual

P/N 487512
January 1979
Rev. 1 9/80
Rev. 2 2/81

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The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

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*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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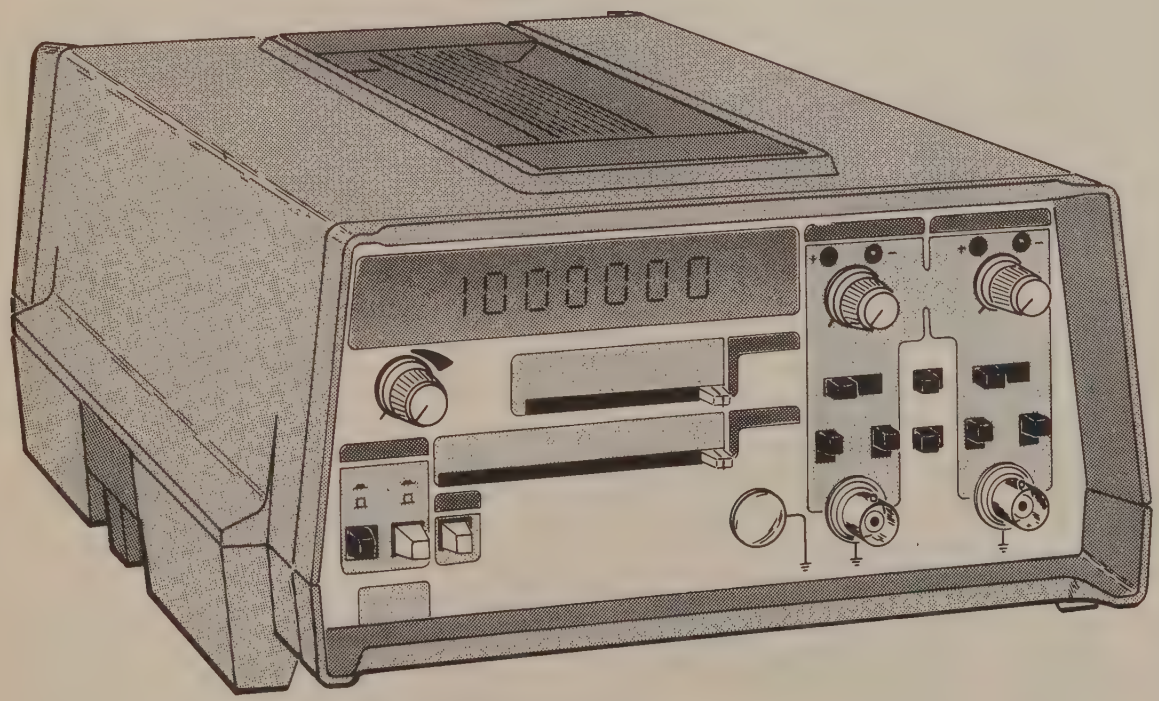


7261A Universal Counter/Timer

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The John Fluke Model 7261A is a bench-type, portable Universal Timer/Counter. A self check mode of operation is provided to verify overall instrument performance. The instrument can make four types of measurements.

1. Frequency, both standard and normalized.

   a. Standard frequency measurements can be made up to 125 MHz (the optional Channel C allows measurements of higher frequencies).

   b. CPM frequency measurements are normalized into units of 100 Counts Per Minute of the frequency input on Channel A.

2. Time measurements of both the period of an input frequency and the time interval between any two events with averaging functions for both to improve accuracy and resolution of the measurements. Period averaging allows a maximum resolution of 0.1 psec or about the length of time it takes light to travel about one ten-thousandth of an inch. Time interval averaging allows a maximum resolution of about 31 psec or about the length of time it takes light to travel about 3 1/2 inches.

3. Ratio measurements of one frequency to another.

4. Totalized count measurements.

1-3. Both Channel A and B have an input impedance of 1 MΩ. Both channels have trigger level controls, trigger status lights, ±slope selection, 3 position attenuator switches, AC/DC coupling select controls, 100 kHz low pass filter select switches, analog trigger level outputs and the capability of being electrically connected together. A marker output is available when either the TI A-B or the TIA A-B function is selected. The optional Channel C has an input impedance of 50Ω and is ac-coupled. This channel is used for frequency measurements only and has no Front Panel controls.

1-4. Measured data is displayed via an 8-digit LED readout on the front panel. This display has leading zero suppression and automatic decimal point positioning. Annunciators are provided to indicate Gate, Overflow, Oven and display units. All displayed information is also available, in serial BCD format, at a rear panel connector when the unit is equipped with an optional Data Output Unit (DOU).

1-5. Power requirements are 100V, 120V, 220V or 240V at 47-63 Hz. The -010 Battery Option allows operation of the instrument away from ac power sources.

1-6. OPTIONS AND ACCESSORIES

1-7. The options and accessories available for use with the 7261A are described in Section 6. Table 1-1 lists these options and accessories.

1-8. SPECIFICATIONS

1-9. Table 1-2 lists the specifications of the 7261A.

Table 1-1. 7261A Options and Accessories

OPTION/ MODEL NO.	DESCRIPTION
	OPTIONS
7261A-190	Jittered Time Base
72XXA-010	Battery
72XXA-112	2 ppm Time Base
72XXA-131	Low Power Oven Time Base
72XXA-132	Superior Low Power Oven Time Base
72XXA-310	520 MHz, Direct
72XXA-521	Data Output Unit
72XXA-529	IEEE Interface Option

OPTION/ MODEL NO.	DESCRIPTION
	ACCESSORIES
Y2014	C Size Single Unit Offset Rack Mount
Y2015	C Size Dual Rack Mount
Y2020	C Size Panel Mount
Y7201	Attenuator/Low Pass Filter
Y7203	2 Foot Ribbon Cable Assembly
Y7204	5 Foot Ribbon Cable Assembly

Table 1-2. 7261A Specifications

FUNCTIONS
(See Footnotes for definition of terms)

Frequency A
Range: 0-125 MHz
Resolution: .1 Hz-10 kHz in decade steps
Accuracy: ±1 count ±time base errors
Display: kHz or MHz with decimal point

CPM X100A
Range: 0-125 MHz
Resolution: 100 CPM, fixed
Accuracy: ±1 count ±time base errors
Display: no decimal point or annunciators

Frequency C
Option -310
Range: 50-520 MHz
Resolution: .1 Hz-10 kHz in decade steps
Accuracy: ±1 count ±time base errors
Display: kHz or MHz with decimal point

Ratio A/B
Range: A: 0-125 MHz
B: 0-2 MHz
Resolution: $\frac{\text{Freq B}}{\text{Freq A X N}}$
Accuracy: $\frac{\text{Freq B}}{\text{Freq A X N}} \pm \frac{\text{Freq B X Trig Error B}}{\text{N}}$
Display: decimal point without annunciator

Period A
Range: 10 ns - 99,999.999 sec
Resolution: 10 ns-1 ms in decade steps
Accuracy: +1 count, ± time base error, ± trigger errors
Frequency Range: 0-2 MHZ, Sinewave
Min. Pulse: 500 ns OHz 100 kHz
250 ns 100 kHz-2 MHz
Display: μsec, msec or sec with decimal point

Period Average A
Range: 0.1 ps - 999,999.99 μs
Resolution: 0.1 ps-10 ns in decade steps
Accuracy: $\frac{10\text{ ns}}{\text{N}}$ ±time base errors ± $\frac{(\text{Trigger error})}{\text{N}}$
Frequency Range: 0-2 MHz, Sinewave
Min. Pulse: 500ns: OHz-10kHz
250ns: 100kHz-2MHz
Display: μsec, msec or sec with decimal point

Time Interval
Range: 10ns-99,999.999 sec
Resolution: 10 ns-1 ms in decade steps
Frequency Range: OHz-5MHz, Sinewave
Accuracy: ±count±time base error ±Trigger errors
Min. Pulse: 10 ns
Display: μsec, msec or sec with decimal point

Time Interval Average
Range: 0.1ns-999,999.99 μs
Resolution: $\frac{10\text{ ns}}{\sqrt{\text{N}}}$, N = 1-$10^5$ in decade steps
Accuracy: $\frac{10\text{ ns}}{\sqrt{\text{N}}}$ ±2 ns* ±time base errors ±$\frac{\text{Trigger error}}{\sqrt{\text{N}}}$
Min. Pulse: 10 ns
Dead Time: 4 μs (see Footnote #4)
Display: μsec or msec with decimal point
Frequency Range: 0-5 MHz
* Degrades to 4 ns when operating on batteries.

Totalize A·B
Range: A: 0-125 MHz
B: 0-2 MHz
Count Capacity: 0-99999999
Display: no decimal point or annunciator

Time Interval Holdoff
Range: 20 μsec-20 msec
continuously adjustable

Table 1-2. Specifications (cont)

SIGNAL INPUTS

Channel A & B

Range: 0-125 MHz (DC coupled)
5 Hz -125 MHz (AC coupled)
Sensitivity: 10 mV rms, 0-50 MHz
15 mV rms, 50-100 MHz
35 mV rms, 100-125 MHz
Min. Pulse: 10 ns and 50 mV peak
Linear Operating Range: +2.5V to −2.5V
Trigger Level Range: +1.5V to −1.5V
Input Impedance: 1 MΩ shunted by 55 pf, nominal
Coupling: AC or DC, switchable
Attenuator: X1, X10, X100
Slope: + or −, switchable
Channel Input: separate or common A, switchable
Filter (3 dB point): 100 kHz low pass, nominal

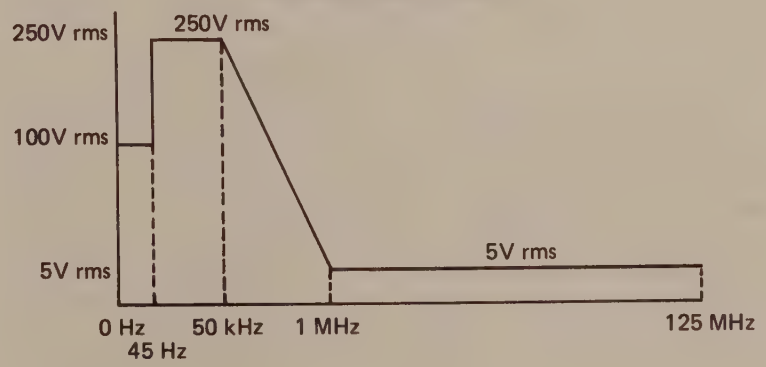
Channel C

Range: 50 MHz-520 MHz (Option -310)
Sensitivity: 10 mV rms
Impedance: 50Ω, 2.5:1 VSWR
Max Input Voltage: 5V rms, fused

External Time Base

Input Frequency: 10 MHz, AC coupled
Sensitivity: 300 mV rms
Impedance: 1 kΩ shunted by 30 pF norminal
Max Input Voltage: 3V rms

Maximum Input Voltage



TIME BASES

Standard

Frequency: 10 MHz
Aging Rate: $\pm 5 \times 10^{-7}$/mon
Temperature Stability: $\pm 5 \times 10^{-6}$, 0°-40°C
Line Voltage (±10%): $\pm 1 \times 10^{-7}$
Battery: $\pm 1 \times 10^{-7}$

Table 1-2. Specifications (cont)

OPTIONS

	-112	-131	-132
Frequency	10 MHz	10 MHz	10 MHz
Aging Rate (constant temperature)	$\pm 3 \times 10^{-7}$/mo ($\pm 1 \times 10^{-6}$/yr)	$\pm 1 \times 10^{-7}$/mo*	$\pm 3 \times 10^{-9}$/day* ($\pm 5 \times 10^{-8}$/mo)*
**Temperature Accuracy (0-40°C)	$\pm 2 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	$\pm 3 \times 10^{-8}$
Line Voltage (±10% change)	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 4 \times 10^{-9}$
Battery	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$
*** Warmup 10 min		$\pm 5 \times 10^{-7}$	$\pm 5 \times 10^{-7}$
20 min		$\pm 3 \times 10^{-8}$	$\pm 3 \times 10^{-8}$

* After 5 days continuous operation.
**Accuracy with temperature specification includes errors cuased by temperature variations during operation as well as all calibration errors when calibrated per procedure in the instrument service manual.
***Compared to frequency. 24 hours after turn on.

Battery Pack
Option -010
Operating Time: 2.0 hours typical continuous. Decreases to 1.5 hours typical worst case with option.
Charge Time: 16 hours at room temperature
Battery Type: Nicad, F cells
Charge Protection: Thermistor actuated shut down of charging circuit if battery temperature exceeds 65°C.
Discharge Protection: Automatic low-voltage shut down to prevent over-discharge.

Printer Interface
Option -521
Description: Serial BCD output of all digits and annunciator
Levels: TTL, "1" state low

IEEE Interface
Option -529
Description: Option for interfacing 7261A to IEEE-488 via the Fluke 1120A IEEE Translator. Provides full measurement output capability as well as remote selection of all functions and ranges.
IEEE Repertoire: SH1, AH1, TEØ, L4, LEØ, SR1, RL2, PP0, DC1, DT1, CØ

Time Base Phase Modulation
Option -190
Description: Option for insuring valid time interval averaging of clock synchronous signals by phase modulating internal time base.

520 MHz Channel C
Option -310
Description: Provides a third input channel for measuring frequencies from 50 MHz to 520 MHz
Sensitivity: 10 mV rms
Input Impedance: 50Ω, VSWR 2.5:1
Max Input Voltage: 5V rms, fuse protected

Table 1-2. Specifications (cont)

GENERAL

See Figure 1-1 for dimensions.

Display:	8 digit, LED with leading zero suppression, decimal point and annunciators
Cycle Rate:	Fixed, 250 ms between readings
Reset:	Reset button clears display, lights all display segments and, on release, activates a new measurement.
Self Check:	Uses internal 10 MHz signal to check digital circuits.
Time Base Output:	Buffered, TTL compatible, 10 MHz signal derived from crystal time base VOUT ⩾ 500 mV into 50Ω
Storage Temperature:	–40°C to +70° C.
Operating Temperature:	0° to 40°C.
Power:	47-63 Hz; 100V/120V/200V/220V ±10%, 32 VA max.
Marker Output:	TTL compatible output, positive going edge indicates A channel trigger, negative going edge indicates B channel trigger. 30 ns delay, typical, from time signal triggers input amplifier to the time marker changes level at rear panel.
Trigger Level Output:	±1.5V level. Indicates DC trigger level set on either Channel A or Channel B, switch selectable.
Autoranging:	Automatically selects range that optimizes both resolution and measurement time. 20% ranging hysteresis is provided to eliminate unnecessary ranging on signals near range edge.
Overflow Indicator:	LED is illuminated to indicate loss of most significant digit information.
Oven Indicator:	LED is illuminated whenever power is being applied to internal oven oscillator.
Trigger Status Indicators:	Two per channel. Provide relative indication of whether the input signal is triggering input amplifier and where on the signal the trigger occurs.
Gate Light:	LED is illuminated whenever counter is making a measurement.
Cont/Trig Mode:	Switch activates external trigger mode for initiating a measurement.
Battery/Line Switch:	Switch provides for manual selection of line power or optional battery power.
EMI:	Internal metal RFI shield (tested and passed MIL-STD-461 notice 3) contact factory for test data.
Weight:	3.1 kg (6 lbs, 14 oz)
Dimensions:	Standard type "C" PTI case (see figure 1-1)
PROTECTION CLASS:	CLASS 1 (As defined in IEC 348).

FOOTNOTES:

1. *$N = 10^0$ to 10^5 in decade steps, set by resolution switch. Indicates the number of periods averaged in Period Average mode, the number of cycles of B averaged in Ration mode, and the number of intervals averaged in Time Interval Average mode.*

2. *Time base error is the sum of all errors specified in the time base section for the particular time base.*

3. *Trigger error is the measurement error caused by noise on the input signal tiggering the input amplifier too early or too late. If is calculated as follows:*

$$\text{Trigger Error} = \pm \frac{2X \text{ peak noise voltage}}{\text{signal slew rate at trig point } V/\mu s} \quad \mu s$$

4. *The counter will ignore time intervals occuring during the dead time.*

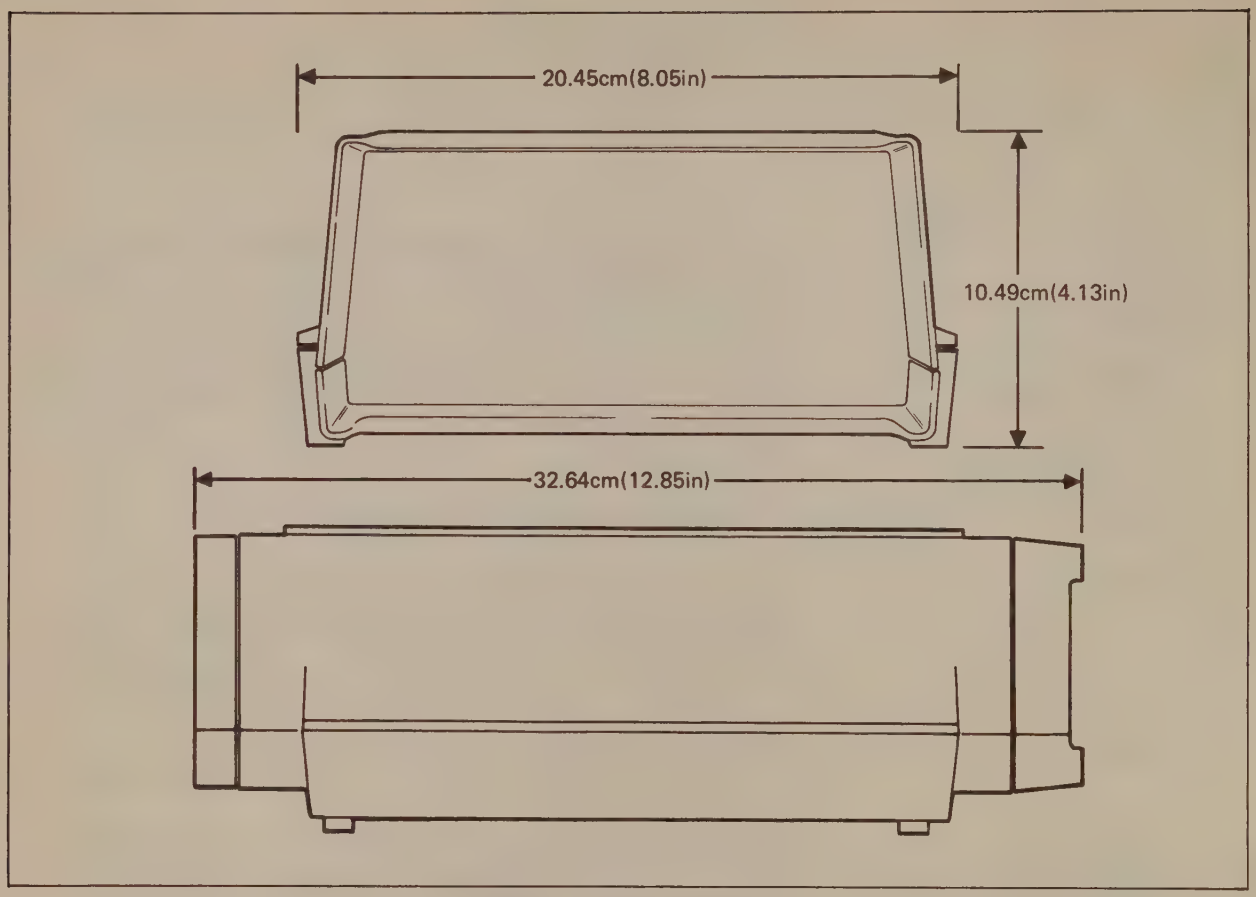
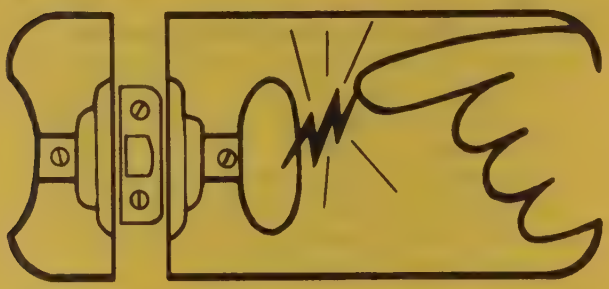


Figure 1-1. Outline Drawing

static awareness

A Message From

John Fluke Mfg. Co., Inc.

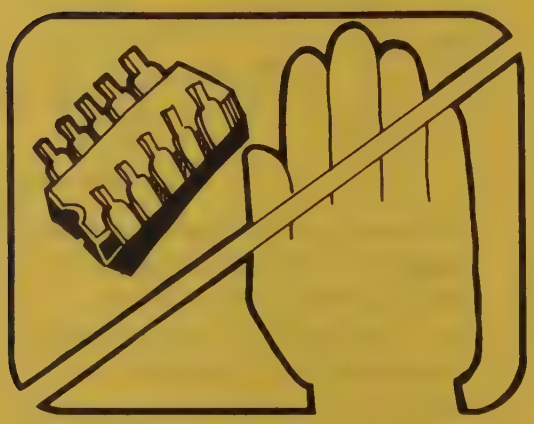


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

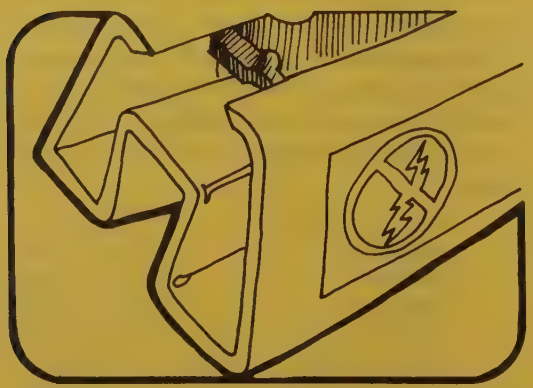
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

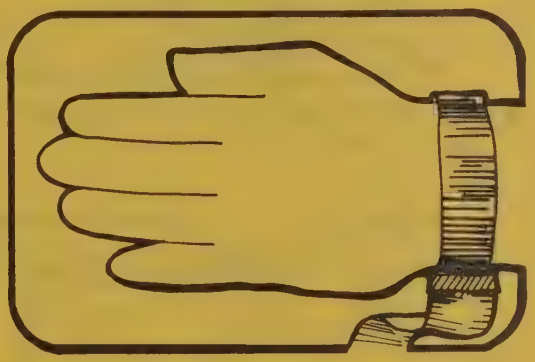
The following practices should be followed to minimize damage to S.S. devices.



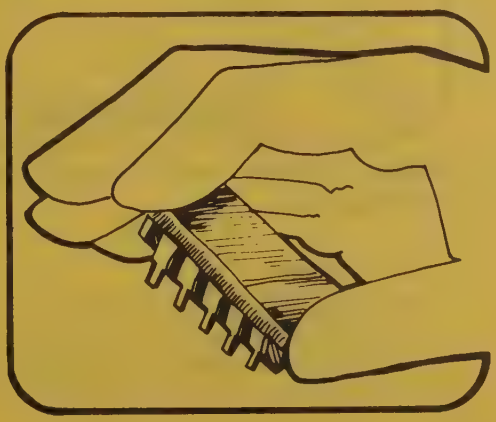
1. MINIMIZE HANDLING



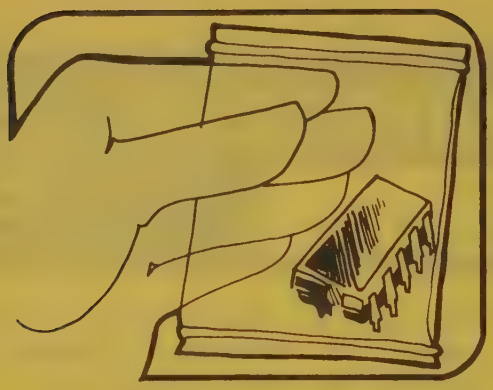
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



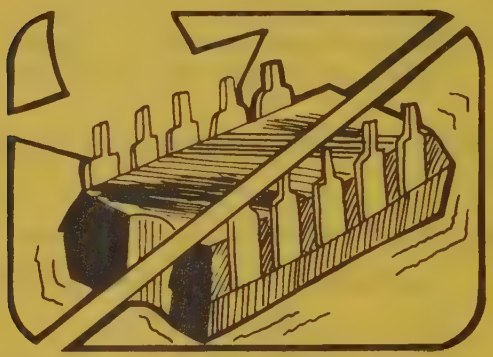
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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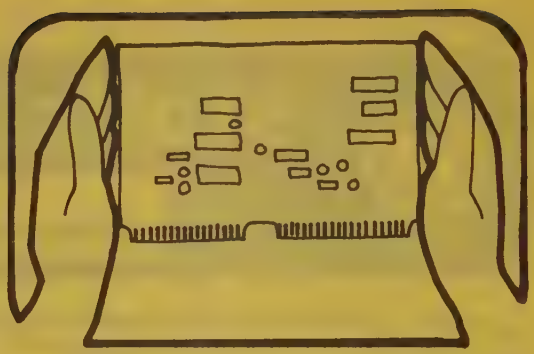
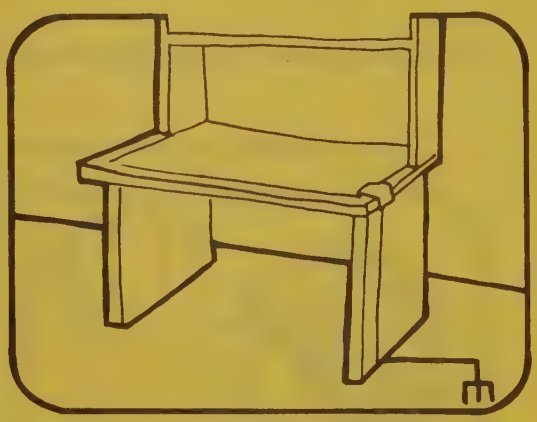


8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



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10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet 30"x60"x60 Mil P/N RC-AS-1200 $20.00	Wrist Strap P/N TL6-60 $7.00

® Dow Chemical

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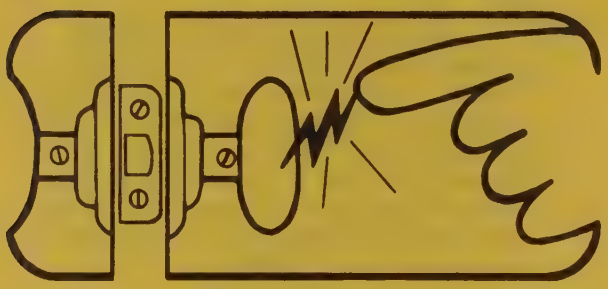

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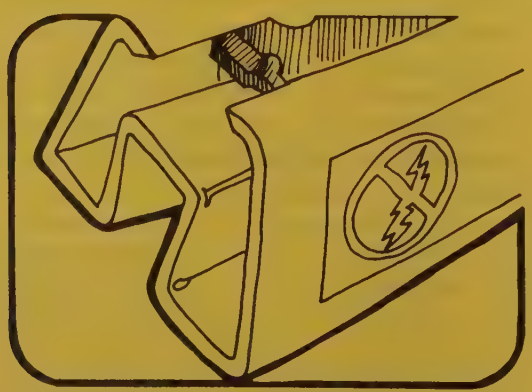

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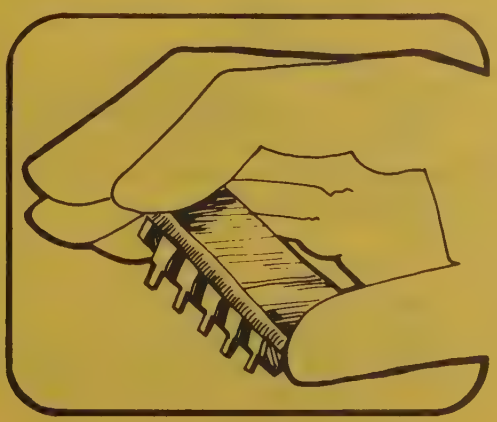

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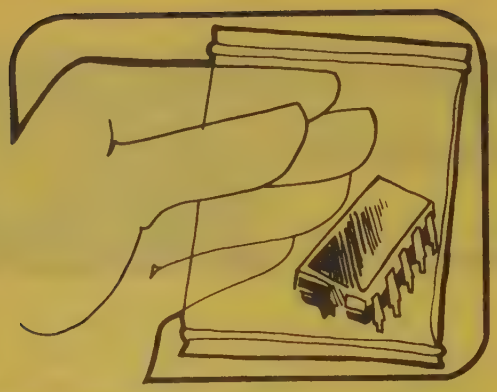

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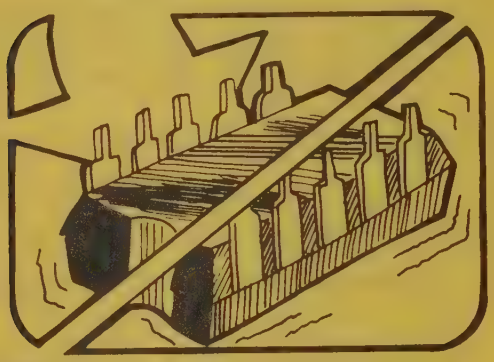

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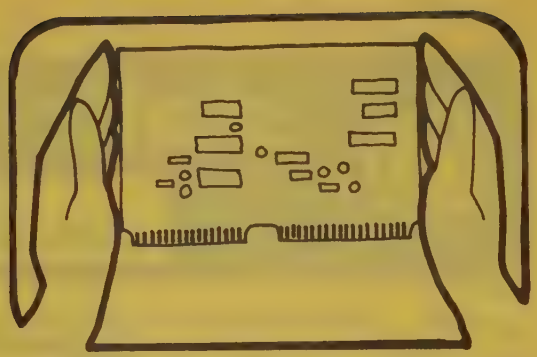

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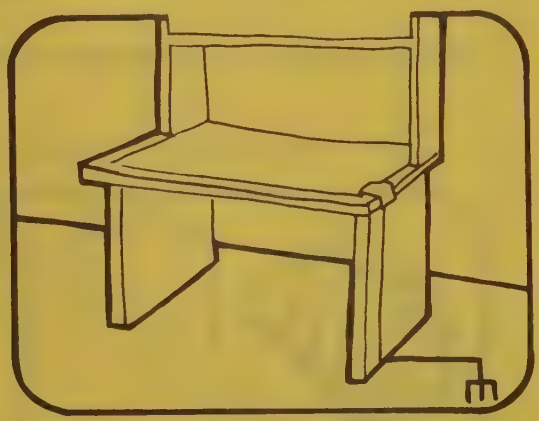

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Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. Installation and operation of the 7261A Universal Counter/Timer are explained in this section. Read this information before attempting to operate the unit. Should any difficulties arise, contact your nearest Fluke Sales Representative (listed in Section 7), or the John Fluke Mfg. Co., Inc. (P.O. Box 43210, Mountlake Terrace, WA., 98043; Telephone 206 774-2211).

2-3. SHIPPING INFORMATION

2-4. The 7261A is packaged and shipped in a foam-packed container. An Instruction Manual and any accessories ordered will be included with the instrument. Upon receipt of the instrument, make a thorough inspection for proper contents and possible shipping damage. Special instructions for inspection and claims are included with the shipping container. If reshipment is necessary, use the original container. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument model number when requesting a new shipping container.

2-5. INSTALLATION

2-6. Input Power

2-7. The 7261A can be operated with an input line voltage of 100, 120, 220, or 240V ac (±10%). Line frequency may vary between 47 and 63 Hz. Before connecting the power cord, verify that line voltage switches (located inside the instrument) are properly set and that an appropriate line fuse is installed. Refer to Section 4 of this manual for proper verification procedures (see "Line Voltage Selection" and "Fuse Replacement").

2-8. Instrument Case Mating

2-9. The 7261A is contained in a molded instrument case with non-marring feet, a tilt-down bail, and a latching arrangement. This instrument may be stacked and latched together with other Fluke instruments employing this type of case.

2-10. Use the following procedure when attaching these molded cases together:

1. For the top instrument, pull out latches found on either side (refer to Figure 2-1).
2. Nestle top and bottom instruments together.
3. Push latches in to secure instruments together.

CAUTION

Instrument stacks should be limited to a total height of three feet and a total weight of 40 pounds.

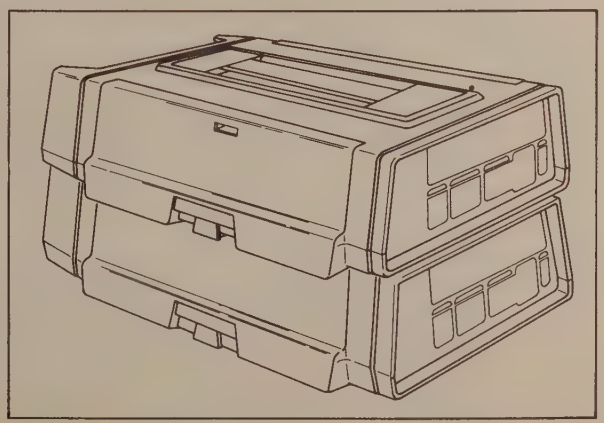


Figure 2-1. Instrument Case Mating

2-11. Tilt-Down Bail

2-12. When used as a separate instrument, the 7261A may be tilted up, or down, with the aid of the tilt bail. When extended, the bail may be locked in place by firmly pressing the legs into slots provided in the bottom panel. When retracted, the bail lies flush with the instrument's bottom panel and does not interfere with case mating. This bail will normally be mounted toward the front of the instrument's bottom panel. To remove the bail, compress either of its legs toward the center of the case and pull out. Installation may then be made in identical mounts at the rear of the bottom panel.

2-13. Rack Installation

2-14. The 7261A may be installed in a standard 19-inch equipment rack or a DIN panel mount. Mounting kits for these accessories are described in Section 6 of this manual. A list of all available accessories and options is presented in Section 1.

2-15. OPERATING FEATURES

2-16. The location of front panel controls, indicators and connectors is shown in Figure 2-2. Referenced by number, these items are briefly described in Table 2-1. Rear panel controls and connectors are covered in a similar fashion in Figure 2-3 and Table 2-2. It is suggested that the operator become acquainted with this information before operating the instrument.

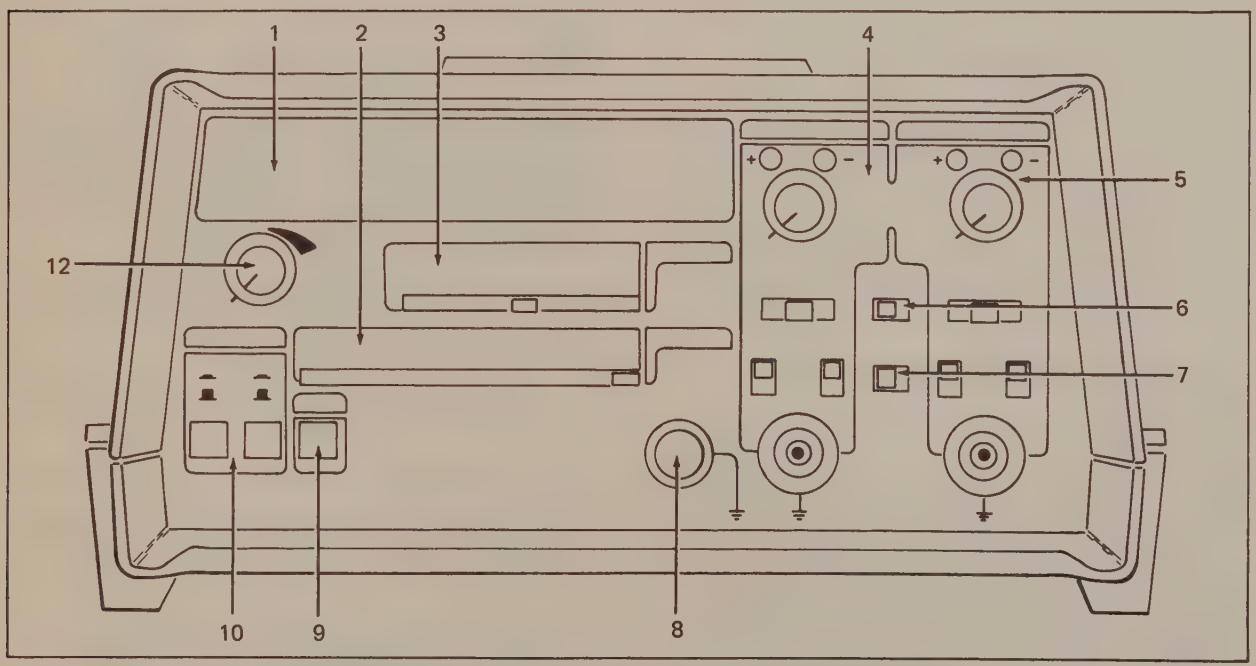


Figure 2-2. 7261A Front Panel Controls, Connectors and Indicators

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators

REF NO.	NAME	FUNCTIONS
1	Display	The display has three sections: 1. At the left end, the instrument status annunciators: GATE Indicates that the instrument is sampling the input signal. OVFL Indicates that the capacity of the display has been exceeded. OVEN If one of the oven time base options is installed, indicates that the oven is receiving power. 2. In the center, the eight LED digits. These digits present the measured value of the unknown input. The value may range between 00000000 and 99999999. 3. At the right end, the display units annunciators. For all instrument functions except CPMX100A, RATIO A/B and TOT A·B, the LED beside the appropriate unit of measurement will be illuminated.

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators (cont)

REF NO.	NAME	FUNCTIONS
2	FUNCTION	A ten position slide switch that determines what measurement function the instrument will perform. Changing the position of the Function Switch automatically resets the instrument. The basic instrument function for each position of the Function Switch is: FREQ A — Measures the frequency of signals applied to Channel A. Can measure signals from 0-125 MHz. CPM X100A — Measures the frequency of the signal applied to Channel A and automatically displays the value inCounts Per Minute times 100. Range is 0-125 MHz. FREQ C — Measures the frequency of signals applied to the optional Channel C. 72XXA-310 Option has a range of 50-512 MHz. RATIO A/B — Measures the ratio of the frequency of the signal applied to Channel A to the frequency of the signal applied to Channel B. Apply the signal with the higher frequency to Channel A. Range of the channels: Channel A: 0-125 MHz Channel B: 5 Hz-2 MHz PER A — Measures the period of signals from 0-2 MHz applied to Channel A. PER AVG A — Measures the period of a predetermined number of cycles of the signal applied to Channel A and displays the average value of these periods. The range in frequency of the signal is 0-2 MHz. TI A—B — Measures the interval in time between the arrival of a signal applied to Channel A and the arrival of a signal applied to Channel B. Dead time (time between one STOP pulse and the next START pulse) must be greater than 200 ns. TIA A—B — Measures a predetermined number of Time Intervals (as defined above) and displays the average value of these periods. Minimum dead time is 200 ns. TOT A·B — Counts the total number of events occuring on Channel A that are gated by events occuring on Channel B. CHK — This is an internal self test of the instrument. It provides a confidence check of all but the input circuits and time base. The frequency displayed should be 10 MHz.
3	RESOLUTION	A seven position slide switch that determines the resolution (range) of the display. Generally, the further right the Resolution Switch position, the longer the instrument's Gate Time. Changing the position of the Resolution Switch automatically resets the instrument. Except for the AUTO position, the position of the Resolution Switch determines the position of the decimal point in the display for all instrument functions except CPM X100A (resolution permanently set at 100 Counts Per Minute).
4	CHANNEL A	1. ±Trigger Status Indicators. Each time Channel A triggers, the appropriate indicators blink. At high frequencies, the indicators will appear to be lit continuously. The indicators work in conjunction with the Trigger Level Control. 2. Trigger Level Control. This control is a variable resistor with a switch in the extreme counterclockwise position. The switch position is PRESET. PRESET selects a trigger level of zero volts. This is the most sensitive trigger level for ac-coupled symmetrical inputs. When the control is rotated out of the PRESET position, it adjusts the triggering point of Channel A about zero volts in a range of +1.5V to −1.5V.

Table 2-1. 7261A Front Panel Controls, Connectors and Indicators (cont)

REF NO.	NAME	FUNCTIONS
		3. ATTEN is a three position slide switch used to reduce high amplitude input signals so that they fall within the dynamic range of the input amplifier. The input signal is attenuated by the factor indicated above the switch positions. 4. AC/DC is a two position slide switch that selects the type of signal coupling used. DC coupling is used to maintain a consistent trigger point on input signals down to a frequency of zero. AC coupling is used when measuring a signal with a large DC offset. (When AC coupling is selected, the trigger point changes with both the input frequency and duty cycle.) 5. +/— is a two position slide switch that selects which slope (positive or negative) of the input signal Channel A will trigger on. 6. BNC connector used to apply input signal to Channel A. Impedance at this terminal is 1 MΩ for connecting directly across an input signal with minimum input waveform distortion. (Important for all time measurement functions, i.e., period, time interval, time interval averaging, etc.). The amplitude of signals applied to this input should not be below 10 mV rms or above the levels shown in Table 2-3. The input circuit is fuse protected.
5	CHANNEL B	This outlined position of the front panel contains the controls, indicators and connector for Channel B inputs. Item locations and functions correspond directly with those of Channel A.
6	SEP/COM	A two position slide switch that determines whether the inputs of Channel A and Channel B are tied together (COM) or separate (SEP). For most types of measurements, this switch will be in the SEP position but the COM position is useful for measurements made on a single signal from a single input cable. (Such as rise time and fall time.)
7	FILTER OUT/IN	A two position slide switch that effectively places a 100 kHz low pass filter in series with the input signals on Channels A and B (the IN position) or allows the input signals to pass with no filtering (the OUT position).
8	CH C	BNC connector for the optional Channel C. Only the frequency of Channel C inputs may be measured. The range of the -310 Option is 50-512 MHz. The input impedance is 50Ω to provide proper impedance matching for 50Ω cables to minimize reflected waves. Maximum input is 5V rms. The input circuit is fuse protected.
9	RESET	The RESET control is a momentary contact pushbutton that provides the capability to manually reset the instrument. When the RESET control is depressed, the display will be all 8's. With this character displayed, each segment of every digit of the display may be checked. Decimal point position will depend on the position of the Resolution Switch.
10	POWER	Both of these controls are two position push-push switches (do not attempt to pull either switch to the out position). The ON/STBY switch in the ON position connects the outputs of the power supplies to the instrument circuitry. If the ON/STBY switch is in the STBY position the outputs of the power supplies are not connected to the instrument circuitry. If an oven time base option is installed, the oven receives power when the ON/STBY switch is in the STBY position and the Rear Panel REF switch is in the INT position. The BAT/LINE switch is bypassed on instruments that do not have the -010 Battery Option installed. If the option is installed, refer to the Operating Instructions for the -010 Option in Section 6.
11	TI HOLDOFF	This control is a potentiometer. It provides continuously variable time delay before the STOP pulse can be generated in the TI A-B and TIA A-B functions.

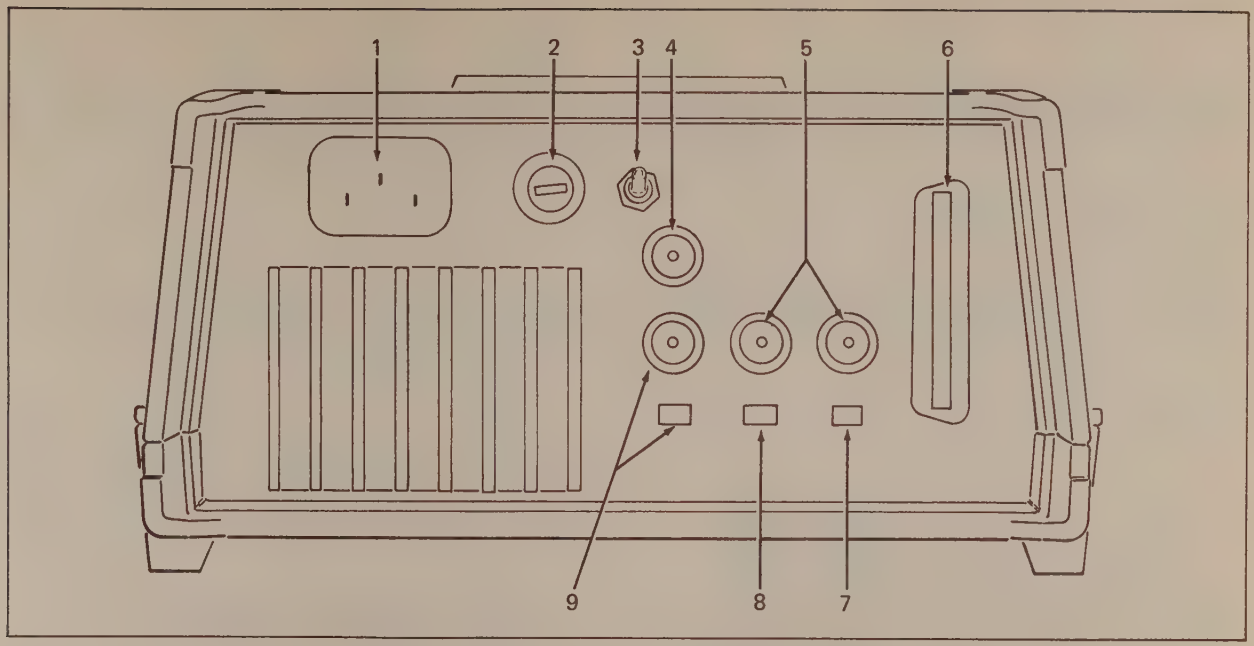


Figure 2-3. 7261A Rear Panel Controls and Connectors

Table 2-2. 7261A Rear Panel Controls and Connectors

REF NO.	NAME	FUNCTIONS
1	POWER RECEPTACLE	Polarized, 3-prong connector for line power input.
2	F1	Main Power Fuse.
3	AC POWER	Connects (ON) or disconnects (OFF) line power to the primary side of the Main Power Transformer.
4	MARKER OUT	Marker pulse output during TI A-B and TIA A-B functions to assist in operator in setting the Trigger Levels.
5	10 MHz REF IN	BNC terminal allows connection of an external time base.
	OUT	BNC terminal that has 10 MHz time base signal used by the instrument.
6	DATA I/O	Connector for DOU Option (-521).
7	REF	Two position slide switch to select time base used by the instrument. INT position selects installed time base. EXT position selects external time base connected to the 10 MHz IN terminal.
		NOTE *If either oven time base option is installed in the instrument, the EXT position of the REF switch removes oven power, allowing the internal time base to cool.*
8	MODE	Two position slide switch determines triggering mode of the instrument. CONT position selects continuous triggering. TRIG position selects single triggering.
9	TRIGGER LEVEL CHA/CHB	Two position slide switch determines whether the trigger level voltage of Channel A or Channel B is connected to the Trigger Level Out terminal.
	OUT	BNC connector with the trigger level of the channel selected by the Trigger Level control.

2-17. OPERATING NOTES

2-18. The following paragraphs describe various conditions and information which should be considered before operating the Model 7261A Counter/Timer.

2-19. AC Line Connection

2-20. The input power cord is a three-pin polarized connector which permits connection to any of the power voltages described in INPUT POWER. Ensure that the ground pin is connected to a high quality earth ground.

2-21. Maximum Inputs

WARNING

ALL BNC CONNECTOR SHELLS ON THE 7261A ARE TIED DIRECTLY TO EARTH GROUND THROUGH THE POWER PLUG. DO NOT CONNECT THE ACTIVE LEAD OF THE INPUT SIGNALS TO THE SHELL. IRREPARABLE DAMAGE TO THE INSTRUMENT OR THE SIGNAL SOURCE MAY RESULT.

2-22. Table 2-3 defines the maximum allowable signal level input for each input terminal. Channels A and B are fuse protected (250 mA). Refer to Section 4 of this manual for fuse replacement instructions.

Table 2-3. Overload Protection

INPUT TERMINAL	MAXIMUM INPUT
Channel A Channel B	100V rms from 0 to 45 Hz, 250V rms from 45 Hz to 50 KHz, then the maximum decreases linearly to 5V rms at 1 MHz and remains at 5V rms above 1 MHz.
Channel C	5V rms
REF, EXT	3V rms

2-23. Counter/Timer Terminology

2-24. The following definitions are useful in understanding how and when to use the 7261A's controls.

2-25. ATTENUATION

2-26. Attenuation is used to limit the input signal within the input amplifier's dynamic range. On the 7261A, an attenuation control is provided to limit the input amplifier's gain. The ATTEN control allows selection factors: X1, X10 and X100.

2-27. CYCLE RATE

2-28. This term refers to the minimum time necessary for the instrument to process and display a measurement. It does not include the actual measurement time. In the 7261A, each cycle time is 250 ms.

2-29. DISTORTION

2-30. Distortion refers to an unwanted change in the input waveform. It may occur at equally spaced (harmonic) or random (non-harmonic) intervals.

2-31. DUTY CYCLE

2-32. Duty cycle specifies the ratio of signal on time to off time. The greater the percentage of off time, the lower the duty cycle. Measure low duty cycle signals with dc-coupling selected (AC/DC switch in the DC position).

2-33. EVENT COUNTING

2-34. The accumulation of a number of events over a period of time is termed event counting. Several 7261A functions perform this operation. The FREQ A mode counts events for a specific length of time to determine the Channel A input frequency. In the CPM mode, the Channel A input frequency is counted in the same manner then a conversion factor is used to normalize the frequency (counts per second) into counts per minute. In TOT A-B mode, a continuously updated count of events on Channel A gated by events on Channel B is displayed. Finally, in RATIO A/B mode, the 7261A will count events on Channel A during a gate time determined by the signal on Channel B. The instrument can measure events generated by a wide variety of sources. For example, the FREQ A function can be used to measure the precision frequency output of a signal synthesizer, and the CPM function can be used to determine the rotational speed of a conveyor belt spindle.

2-35. When using any function that counts events, the instrument must trigger once, and only once for each event. Use of the front panel controls must be directed toward this end. Noise must be filtered or attenuated to prevent false triggering, and the input signal must be kept within the dynamic range of the instrument.

2-36. EVENT TIMING

2-37. During event timing functions, an internal oscillator frequency is counted for a period determined by the input signal. In the 7261A, two types of event timing measurements can be made; period and time interval. Period measurement (PER A or PER AVG A) determines the period, or inverse of frequency, of a repetitive signal. The instrument measures period by counting an internal oscillator's frequency for single

(PER A) or multiple (PER AVG A) cycles of the input. Time interval measurements (TI A-B) can be made to determine the period of time between any two events, repetitive or not. Average time interval measurements (TIA A-B) can be made on signals with repetitive time intervals. For either type of event timing, separate start and stop signals must be generated from the input (refer to Figure 2-4).

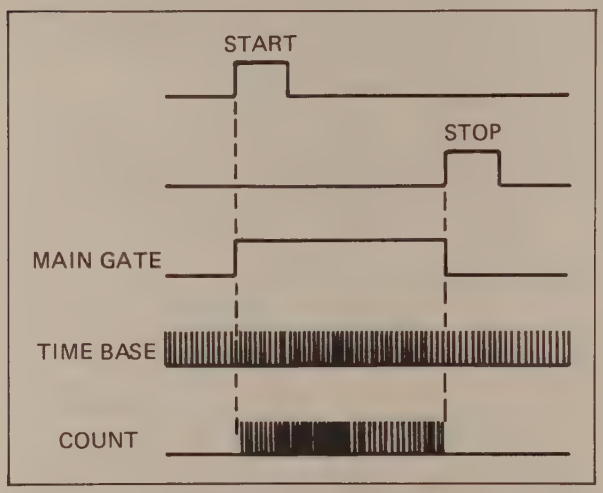


Figure 2-4. Event Timing

2-38. SYNCHRONOUS VERSUS ASYNCHRONOUS TIME INTERVAL REPETITION RATES

2-39. Time Interval Averaging is a statistical reduction of both the time base and trigger errors. Like all true statistical functions, Time Interval Averaging depends upon random sampling. If the repetition rate of the time interval is synchronous with the clock used, time interval averaging may not give the increase in accuracy and resolution expected. In worst case situation of a synchronous repetition rate, Time Interval Averaging will decrease accuracy and resolution. The repetition rate is synchronous with the clock if the time interval always starts in the same place with respect to the clock. As Figure 2-5 shows, asynchronous repetition rates can start anywhere, but synchronous repetition rates have a fixed relationship to clock. The -190 Jittered Time Base Option can be used to ensure asynchronous operation. This option introduces a phase noise "jitter" on the 100 MHz clock frequency to insure asynchronous measurements.

2-40. GATE TIME

2-41. Gate time refers to the length of time during which a frequency is being counted for display. The frequency counted may be derived from the input signal or from the instrument's internal time base. With longer gate times, more counts are accumulated and measurement resolution improves.

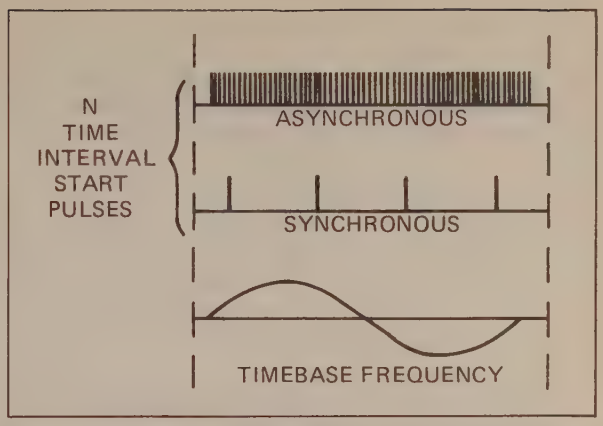


Figure 2-5. Time Interval Repetition Rate versus Time Base

2-42. HYSTERESIS

2-43. In instruments such as the 7261A, proper counting and timing requires a pulsed output from the input circuitry. To form this pulse, each input waveform (regardless of its shape) triggers the input circuitry on or off at predetermined triggering, or hysteresis levels. An input waveform must pass through both of these hysteresis levels for the input circuitry to generate a pulse. The voltage difference between the two levels is termed the hysteresis window; the minimum signal that can trigger both levels therefore defines the instrument's sensitivity. Generation of the hysteresis window is illustrated in Figure 2-6.

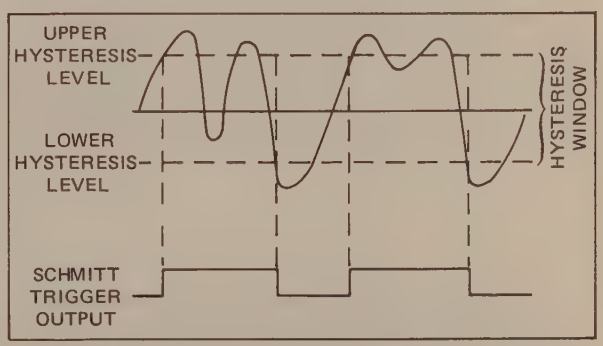


Figure 2-6. Hysteresis Window

2-44. INPUT COUPLING

2-45. Either ac or dc coupling may be used to transfer the input signal to the input conditioning circuitry. If the input signal is riding on a dc level, it may not lie within the range of the hysteresis window. The instrument cannot measure the signal. The top waveform in Figure 2-7 shows such a dc-coupled waveform. The lower waveform shows the same waveform ac-coupled. With ac-coupling the signal can be measured. AC-coupling causes no problems for repetitive signals of a fixed frequency but the trigger

point will shift with a change in frequency or duty cycle. This is not important in event counting but is very important to event timing. Pulse inputs with low duty cycles should not be ac-coupled as the coupling capacitor will not charge high enough for proper triggering.

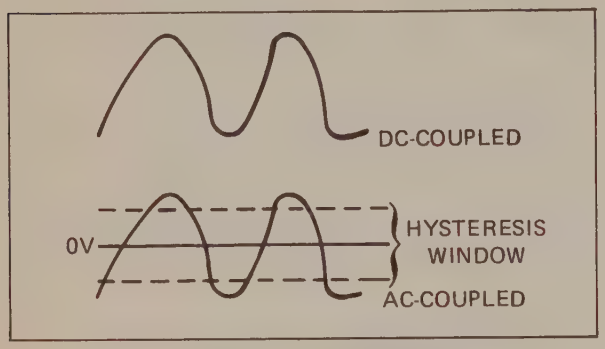


Figure 2-7. Input Coupling

2-46. INPUT IMPEDANCE

2-47. The input impedance defines the impedance seen by a signal source. Input impedance of Channels A and B 1 MΩ shunted by 45 pF. The optional Channel C input impedance is 50Ω.

2-48. LINEAR OPERATING RANGE

2-49. The linear operating range refers to the excursions of the input signal that can reliably trigger the input amplifier without distortion. The 7261A's linear range varies between the smallest signal level acceptable by the input amplifier (minimum) and the largest attenuated signal that will not be clamped by the amplifier's input circuits (maximum). The minimum is defined by the instrument's sensitivity specifications. Operation within maximum levels may be ensured through proper use of the ATTENUATION controls.

2-50. NOISE

2-51. Noise is defined as spurious signals riding on the input waveform. Unlike distortion, the waveform is not changed. Noise of sufficient amplitude can, however, cause false triggering, resulting in inaccurate measurements during event timing functions. The 7261A input amplifiers (signal conditioners) exhibit very low noise. The signal applied to these amplifiers may, however, be plagued with noise from the signal source, the electrical environment or from improper signal transfer to the 7261A.

2-52. ±1 COUNT ERROR

2-53. The one count ambiguity, inherent in any gate and counter type of frequency meter, results from an out-of-phase relationship between the input signal and the internal oscillator signal. The effect is demonstrated in Figure 2-8. During a one second gate time, the top 9.5 Hz signal accumulates a count of ten; during the same gate time, the phase-shifted bottom signal accumulates only nine counts. The ambiguity amounts to one displayed count.

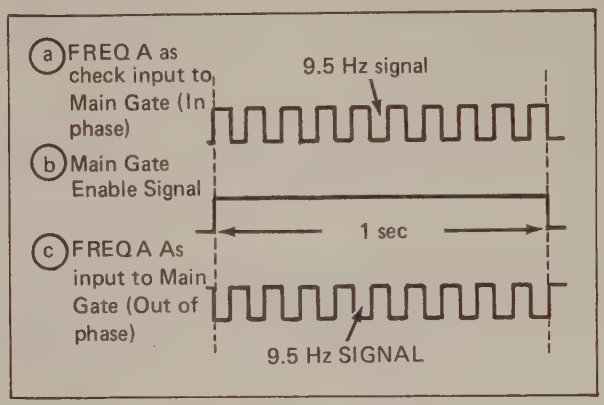

a FREQ A as check input to Main Gate (In phase)
9.5 Hz signal
b Main Gate Enable Signal
1 sec
c FREQ A As input to Main Gate (Out of phase)
9.5 Hz SIGNAL

Figure 2-8. ±1 Count Error

2-54. RESOLUTION

2-55. This term defines the value of the smallest displayed unit in a measurement. In the 7261A, this unit (the least significant digit, or LSD) is defined by each combined setting of the FUNCTION and RESOLUTION controls.

2-56. SENSITIVITY

2-57. Sensitivity defines the smallest signal amplitude capable of triggering the instrument. This specification corresponds to an rms value of the peak-to-peak difference between hysteresis levels (the hysteresis window). Note that the waveform must pass both hysteresis levels before a count is generated from the input circuitry; false triggering from noise or distortion on the input signal is thereby minimized.

2-58. TIME BASE ERROR

2-59. Time base error stems from crystal aging, temperature variation, and line voltage fluctuation. The 7261A may be fitted with one of several available time base oscillators; specifications for each are included in Section 1 of this manual.

2-60. TRIGGER ERROR

2-61. Input signal irregularities (noise, distortion, etc.) may cause premature or delayed triggering at the input circuitry's hysteresis levels. During event counting functions, this error is significant only when extra pulses are generated by the input circuitry. In event timing functions triggering error may be significant; improper triggering translates into inaccurate counting of the

internal oscillator frequency. Figure 2-9 illustrates possible trigger errors.

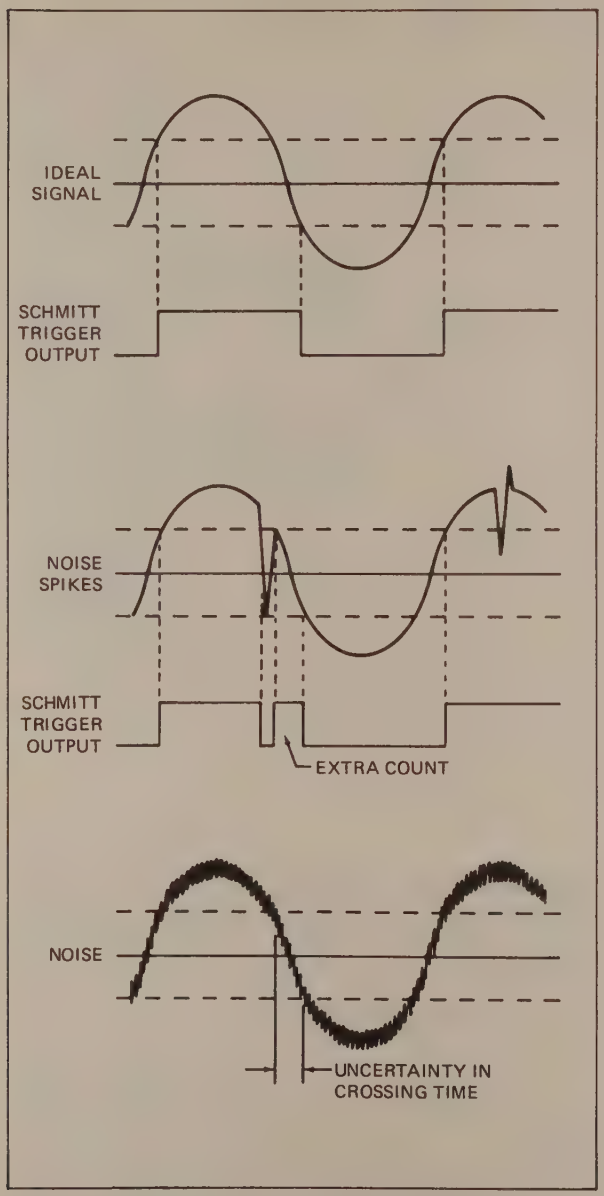


Figure 2-9. Noise and Distortion Effects

2-62. TRIGGERING

2-63. Signal conditioning circuits ideally provide a pulse train output representative of the input signal. These pulses should occur at the same frequency in Event Counting functions. The pulses are the Start or Stop times in Event Timing functions and must have the same time relationship as the input signals. Each pulse is triggered on and off at the specified upper and lower hysteresis levels for the instrument.

2-64. TRIGGER LEVEL

2-65. The voltage level nominally halfway between upper and lower hysteresis levels is termed the trigger level. On the 7261A, the ATTEN control reduces the input signal within the dynamic range or the input amplifier. Then the TRIGGER LEVEL and slope (±) controls select the trigger level. Trigger Level for Channels A and B are available as analog voltages on a rear panel terminal.

2-66. Controls

2-67. FUNCTION CONTROL

2-68. The FUNCTION slide switch determines the type of measurement that the instrument will make. Each change of the switch position generates an internal reset. OPERATING DIRECTIONS provide descriptions, operating limits, and specific procedures for each function.

2-69. RESOLUTION CONTROL

2-70. The front panel RESOLUTION control selects autoranging or one of six manual ranges. Each of these settings is defined by three function-related scales. The scale used with FREQ A, PER A, PER AVG A, RATIO A/B, CHK or TI A-B is discussed with the appropriate OPERATING DIRECTIONS in this section.

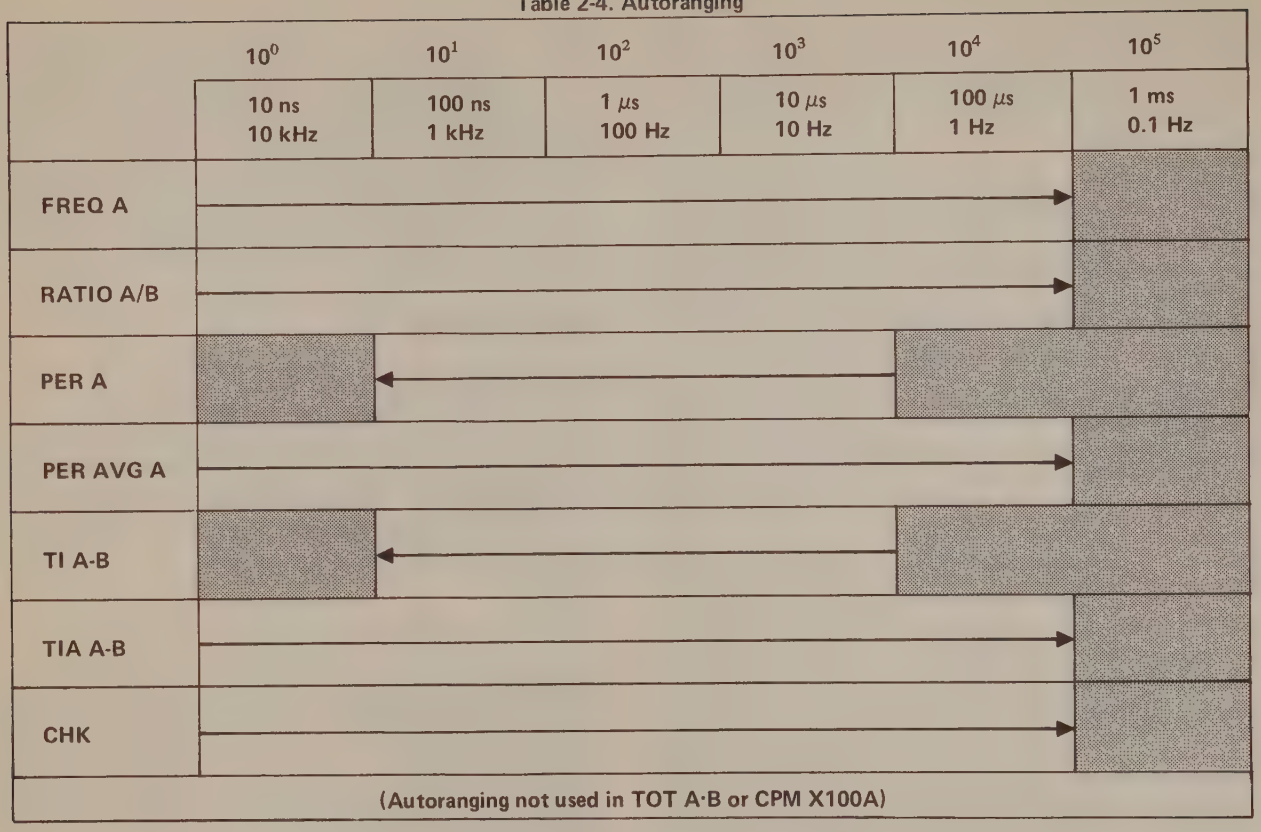
2-71. The RESOLUTION control will have no effect in two functions. For totalizing measurements (TOT A•B), resolution is set at the least significant integer. On the counts per minute mode (CPM X100A), resolution is determined by dividing the number of counts per revolution by the number of minutes. If a 100 count-per-revolution input is used, resolution will translate directly to one RPM.

2-72. When placed in AUTO, the 7261A will automatically step through a predetermined series of resolution settings. The settings available for each function are defined in Table 2-4. When autoranging, the instrument seeks the greatest resolution possible, without overflow, for the function selected and the signal being measured. As an example, with FREQ A selected, the 7261A will step through the first four resolutions to maximize its display capacity when measuring a frequency of 1.2 MHz: the reading will be "1200.000 kHz". If a 1200 Hz is measured, maximum resolution allowable will again be found at the last step, but the reading will be "1.200 kHz".

NOTE

During autoranging in the PER A mode, the GATE LED may flash more than once for each display update.

Table 2-4. Autoranging



2-73. SEPARATE/COMMON CONTROL

2-74. The SEP/COM control is used to select the input to the Channel B amplifier. In SEP, the Channel B input connector is tied to the Channel B amplifier. In the COM position, the Channel A input connector is tied to both the Channel A and B Amplifiers; the Channel A ATTEN and AC/DC controls now influence the signal to both amplifiers. All other Channel B controls affect Channel B signals as usual.

NOTE

In COM, the Channel B input is not connected.

2-75. ATTENUATION CONTROLS

2-76. The ATTEN control is a three position switch that can limit instrument input circuit gain by factors of X1, X10 and X100. Large signals causing distortion or non-linear operation can therefore be reduced to within the instrument's dynamic range. This dynamic range, or area between the hysteresis level and the overload point, varies with frequency. Increased attenuation may also be used to compensate for noise on the input signal; use of ATTENUATION in this case can prevent the noise from crossing one or both of the hysteresis levels.

2-77. SLOPE CONTROL

2-78. The slope (±) control determines instrument triggering order; the initial trigger may occur on a negative going signal (–position) or on a positive going signal (+position).

2-79. FILTER CONTROL

2-80. The position of the Filter IN/OUT switch determines whether or not frequencies above 100 kHz are removed from the input signal. When the control is at the IN position, the upper bandpass limit of the input amplifier on the Preamplifier is lowered from 125 MHz to 100 kHz. If high frequency noise is a problem with a low frequency signal, the 100 kHz low pass filter may be used to advantage.

2-81. TRIGGER LEVEL CONTROL

2-82. Trigger level is selected by the Trigger Level Control. The Trigger Level Control is continuously adjustable between +1.5V and –1.5V. The ±trigger indicators provide the operator with a coarse indication of trigger setting. (The exact level of trigger setting can be measured from the Rear Panel Trigger Level Out Terminal.) The PRESET position of the control selects the zero volts position. The position of the ± switch

determines whether the instrument is set up to trigger on the positive or the negative slope of the waveform Figure 2-10 shows the effects of this control. Use of both the Trigger level and ± (slope) controls will be discussed later in this section under Triggering.

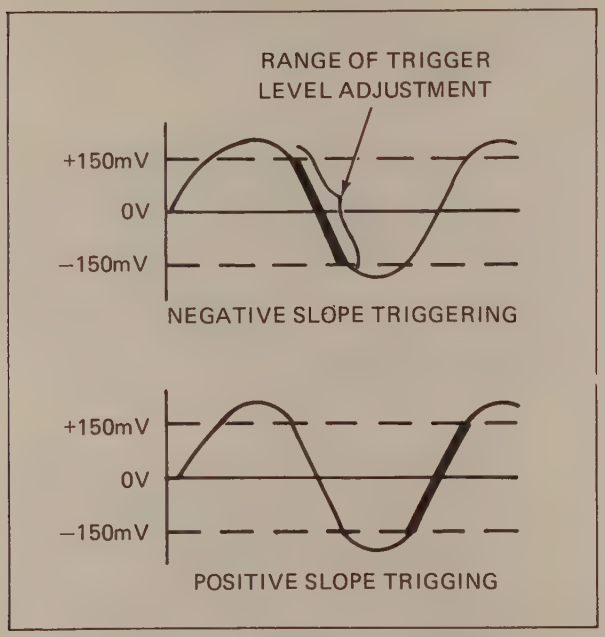


Figure 2-10. Trigger Level Control

2-83. TI HOLDOFF

2-84. The TI Holdoff control provides a continuously adjustable time delay in generating the STOP pulse. The time delay begins from the START pulse. This allows the operator to accurately measure the time interval of some extremely noisy signals. Figure 2-11 shows the waveform of a signal generated by relay contact closure. The noise from contact bounce is so great that without TI Holdoff the STOP signal would occur almost immediately after the START pulse. The time interval measurement would be grossly inaccurate. But the TI Holdoff signal prevents the output of the Channel B signal conditioner from generating the STOP pulse. After the end of th TI Holdoff period, the next pulse out of the Channel B signal conditioner will generate the STOP pulse. The time interval of the signal has been accurately measured.

2-85. MODE CONTROL

2-86. The rear panel trigger MODE control positioned to CONT, the instrument's internal logic will automatically cycle through repetitive measurement routines. When placed in TRIG, a measurement on Channel A can be initiated by using the Channel B signal as a trigger. If the 7261A is in TRIG during remote control operations with the DATA I/O Option -521 installed, refer to Section 6 for special instructions.

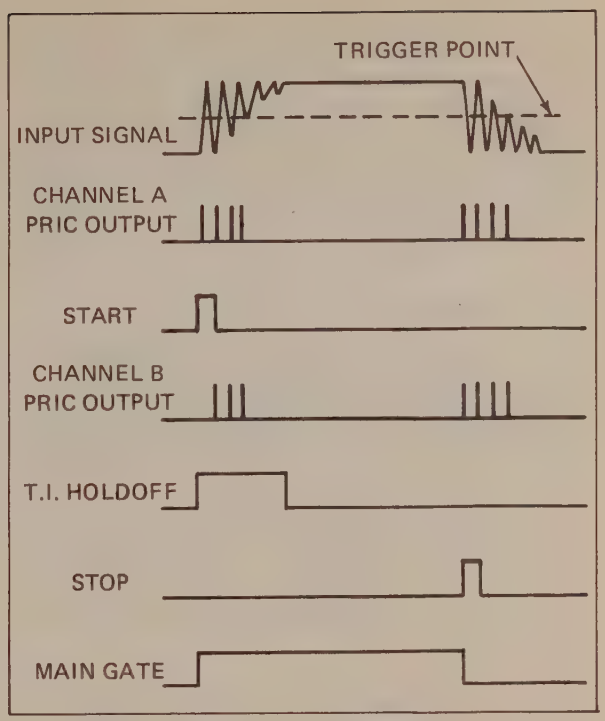
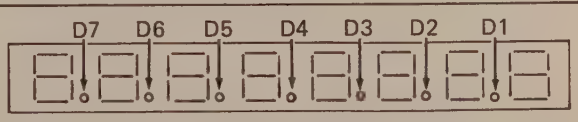


Figure 2-11. T.I. Holdoff

2-87. Display

2-88. The 7261A display presents an eight-digit LED readout with leading zero suppression. Measurement unit annunciators of MHz or kHz will be activated in FREQ A or CHK modes. For PER A, PER AVG A, or TI A-B, annunciators for μsec, msec, or sec will illuminate. There will be no units annunciation in RATIO A/B, TOT A-B, or CPM X100A modes. Decimal point placement is determined by RESOLUTION and FUNCTION settings, as defined by Figure 2-12.



FUNCTION	RESOLUTION 10^0 10ns 10kHz	10^1 100ns 1kHz	10^2 1μs 100Hz	10^3 10μs 10Hz	10^4 100μs 1Hz	10^5 1ms 0.1Hz
FREQ A	D2	D3	D4	D2	D3	D4
CPMX100 A	DOESN'T USE DECIMAL POINT					
FREQ C	D2	D3	D4	D2	D3	D4
RATIO A/B	–	D1	D2	D3	D4	D5
PER A	D2	D4	D3	D2	D4	D3
PER AVG A	D5	D6	D4	D5	D6	D7
T.I. A-B	D2	D4	D3	D2	D4	D3
T.I.A. A-B	D5	D6	D4	D5	D6	D7
TOT A-B	DOESN'T USE DECIMAL POINT					
CHK	D2	D3	D4	D2	D5	D4

Figure 2-12. Decimal Point Placement

2-89. There are three status annunciators. The GATE annunciator provides an indication of counting or timing in progress. The OVFL annunciator will illuminate when the capacity of the internal 8-decade accumulator is exceeded. The OVEN annunciator should be on whenever an oven oscillator (Option -131 or -132) is installed, the instrument is connected to line or battery power (STBY or ON); and the Rear Panel REF switch is in the INT position.

2-90. Accuracy

2-91. Techniques are available for improving the accuracy of any measurement. Even with the controls set for optimum performance, three error factors may degrade accuracy. These errors (one count error, trigger error, and time base error) relate to each function as defined in the following accuracy statement:

1. FREQ A, FREQ C

±1 count ± time base error

2. CPM X100A

±1 count ± time base error

3. RATIO A/B

$$\pm\frac{\pm\,\text{FREQ B}}{\text{FREQ A} \times N}\pm\frac{\text{FREQ B} \times \text{TRIGGER ERROR B}}{N}$$

4. PER A

±1 count clock ± trigger error ± time base error

5. PER AVG A

$$\frac{10\text{ nS}}{N}\pm\text{timebase error}\cdot\frac{\pm\text{ trigger error}}{N}$$

6. TI A-B

±1 count clock ± trigger error ± time base error

7. TIA A-B

$$\frac{\pm\ 10\text{ nS}}{\sqrt{N}}\pm 4\text{ nS}\pm\text{timebase}\frac{\pm\text{ trigger error}}{\sqrt{N}}$$

2-92. Dealing with ±1 Count Error

2-93. There are several methods available for reducing the effect of one count error. The following considerations may be useful:

1. By selecting a longer gate time, the percentage error caused by the ±1 count gate uncertainty is decreased.

2. The accuracy of functions affected by ±1 count A depends upon the frequency of the input signal. As frequency increases, accuracy increases. As frequency decreases, accuracy decreases. The sloped line (±1 count A), in Figure 2-13, illustrates this concept. With a higher frequency input, more counts will be made per gate time, and ±1 count error will become less significant. The percentage error is thereby reduced.

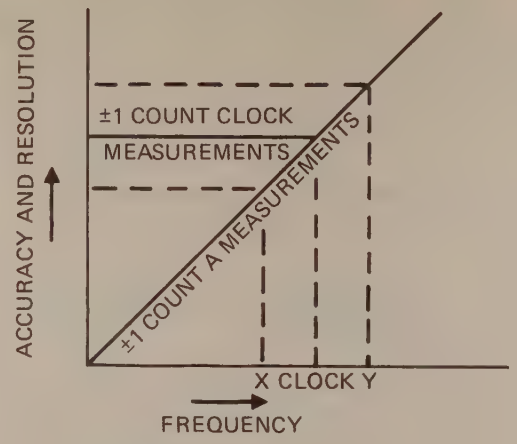
3. The accuracy of functions, affected by the ±1 count clock depends upon the frequency of the clock used. Since the clocks are all based on the precision time base, accuracy is a constant for each clock and is completely independent of the frequency of the input signal. The straight line (±1 count clock) that intersects the ±1 count A line at clock frequency in Figure 2-13 illustrates this function. Any noise or distortion on the input signal will degrade the accuracy level.

4. FREQ A and PER A functions can be used selectively to maximize accuracy of frequency measurements over the range of Channel A. The relationship between the two measurement functions is shown in Figure 2-13. The following can be drawn by this function comparison.

   a. FREQ A provides the best measurement accuracy if the input signal is higher in frequency than the instrument time base oscillator (10 MHz).

   b. PER A provides the best measurement accuracy if the input signal is lower in frequency than the instrument time base oscillator.

5. When using these guidelines, the operator must exercise discretion. In a high noise environment, or where a great deal of non-harmonic distortion might be expected, gate time errors due to improper triggering may be significant; FREQ A might be the better choice regardless of the input signal frequency.



Clock Frequency used for
PER A and TIA B Function

RESOLUTION SWITCH SETTING	CLOCK FREQUENCY
1 ms	1 kHz
100 μs	10 kHz
10 μs	100 kHz
1 μs	1 MHz
100 ns	10 MHz
10 ns	100 MHz

Figure 2-13. Accuracy and Resolution versus Frequency

2-94. DEALING WITH TIME BASE ERROR

2-95. Some of the effects of crystal related time base errors can be reduced. If the temperature of the instrument environment is maintained at a constant value, temperature error is minimized. If tight control of the instrument environment fails to produce the accuracy desired, the time base crystal related error can be reduced through recalibration or by substituting a time base with smaller errors. This time base may either be one of the optional internal time bases described in Section 6, or an external 10 MHz reference connected to the instrument via the rear panel.

2-96. DEALING WITH TRIGGER ERROR

2-97. Improperly triggered hysteresis levels can cause error when using any function. When using ratio or event timing functions, trigger errors produce gate time errors, resulting in inaccurate counts. Proper use of ATTENUATION and FILTER controls, along with other noise reduction techniques, will help solve this problem. In addition, the following considerations should be kept in mind:

1. Period measurements use Channel A for both START and STOP pulses; triggering errors are from one channel only. Trigger error will be caused by noise on the input signal. The period averaging function will reduce the effect of the triggering error by a factor of $1/N$.

2. Time interval measurements use both Channel A and channel B for the START and STOP pulses; the trigger error may arise from either or both channels. The averaging function will reduce the effect of the triggering error by a factor of $1/\sqrt{N}$.

3. In the ratio mode, the counts of Channel B trigger error increase as the frequency of the Channel A input signal increases.

4. A pulse input signal, with faster rise times, will exhibit less trigger error than a sine wave input.

2-98. REDUCING ERRORS DUE TO NOISE ON THE INPUT SIGNAL

2-99. The following techniques may also be used to ensure noise rejection:

1. Use an oscilloscope to identify the presence of noise.

2. Use the X10 ATTEN control to limit noise levels while maintaining sufficient signal levels for triggering.

3. Use an oscilloscope probe (X10) as the input cable when measuring high impedance circuits.

4. Use a low pass filter/attenuator. The front panel FILTER control can be utilized to attenuate signals above 100 kHz. Alternately, the Fluke Model Y7201 Filter/Attenuator, attached to the front panel input connector, can be used to suppress unwanted noise. This accesssory is described in Section 6 of this manual.

2-100. SUMMARY

2-101. Some of the errors that affect accuracy are inherent and cannot be much improved without substituting different components (time base error). Accuracy can be improved by using the proper techniques

(triggering error) or by selecting the correct function (PER A versus FREQ A). The accuracy of the event timing functions can be improved by using the appropriate averaging function. And, sometimes, the technique that decreases the effect of one error source increases the effect of another error source. Noise and distortion on the input signal or signals also affect the accuracy of measurement. The operator has to be aware of all facets of the error sources and exercise discretion in using the instrument to make precise measurements.

2-102. OPERATING DIRECTIONS

2-103. Operation of the 7261A for each function is described in the following paragraphs. Function capabilities, as well as useful operating hints, are also presented here.

2-104. Initial Procedure

2-105. The following procedural checks should be performed prior to using any of the function operating directions.

1. Check that the instrument has been connected to appropriate line power.

2. Ensure that the rear panel EXT-INT select switch is set to INT.

3. Press power to ON.

4. Ensure adequate time for instrument warmup, especially if an optional oven time base is installed (typically 10 minutes).

2-106. Frequency Measurements (FREQ A)

2-107. Frequencies on Channel A from 0 - 125 MHz can be counted and directly displayed using this function. The gate times available range from 0.1 ms through 10s in six decade steps selectable with the RESOLUTION control (respective markings of the 10 kHz through 0.1 Hz). Input amplitudes should not exceed 250V rms from 45 Hz to 50 kHz, lowering to 5V rms at 1 MHz and above). Use the following procedure when making frequency measurements:

1. Set front panel controls as follows:

FUNCTION	- FREQ A
RESOLUTION	- as required, or AUTO
ATTENUATION	- X100
TRIGGER LEVEL	- PRESET
SEP/COM	- SEP
FILTER	- Out

2. Connect the signal to be measured to the CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls for a stable display.

4. Set the RESOLUTION control to obtain desired resolution of the displayed frequency. The OVFL annunciator will light if the display's capacity is exceeded.

NOTE

When dealing with low frequencies, period measurements yield greater accuracy.

2-108. Counts per Minute Measurements (CPM X100A)

2-109. The 7261A can be used as a tachometer to read out revolutions per minute. The input to Channel A in this function must be from a 100 pulse per revolution transducer. For transducers having other pulse per revolution rates, the 7261A readout can be converted to RPM with the formula:

$$\text{Correct RPM} = \frac{100 \text{ Displayed RPM}}{N}$$

Where N = the number of pulses per minute of the transducer.

When the CPM X100A function is selected, gate time is set to 0.6s, the RESOLUTION control is disabled, and the display will not indicate a decimal point or units annunciator. Use the following procedure when making counts per minute measurements:

1. Set front panel controls to:

FUNCTION	- CPM X100A
SEP/COM	- SEP
FILTER	- Out

2. Connect the transducer output to the CHANNEL A input terminal.

3. Adjust the ATTEN and TRIGGER LEVEL controls to ensure proper triggering.

NOTE

The output voltage from magnetic transducers will vary with speed of revolution. The ATTEN and TRIGGER LEVEL control settings may, in such cases, need to be changed. Alternately, a photo-electric transducer will provide an output level not dependent on frequency.

2-110. Frequency Measurements (FREQ C)

2-111. Frequency measurements can be made above the range of FREQ A measurements using this optional function. Direct frequency measurements can be made in the range 50-520 MHz with the -310 Option installed. This option is discussed in detail in Section 6. Assuming the option is installed:

1. Set the Front Panel controls as follows:

FUNCTION	- FREQ C
RESOLUTION	- as required

2. Connect the signal to be measured to the Channel C input connector.

3. Set the RESOLUTION control to obtain maximum resolution of the displayed frequency. The OVFL annunciator will illuminate if the display capacity is exceeded.

2-112. Ratio Measurement (RATIO A/B)

2-113. The ratio function can be used to measure the numeric ratio of two input signals. The input on CHANNEL A is divided by that on CHANNEL B. The result is displayed without measurement unit annunciation. The RESOLUTION control influences the display resolution in the normal manner. Use the following procedure when making ratio measurements.

1. Set front panel controls as follows:

FUNCTION	- RATIO A/B
RESOLUTION	- set to optimize displayed resolution
SEP/COM	- SEP
FILTER	- Out (both channels)

2. Connect the higher of the two frequencies to CHANNEL A input connector.

3. Connect the lower of the two frequencies to CHANNEL B input connector (5 Hz through 2 MHz).

4. Adjust the ATTEN and TRIGGER LEVEL controls on both channels for proper triggering. (GATE LED flashing.) Gating is derived from the CHANNEL B signal when in the Ratio function; generally, the greater the level of the signal on CHANNEL B, the greater the accuracy of the Ratio measurement will be.

NOTE

It may be necessary to check each signal separately in FREQ A or PER A to verify correct levels.

5. Set the RESOLUTION control to obtain maximum resolution of the ratio measurement.

2-114. Period Measurements (PER A)

2-115. This function can be used to measure the period of an input signal with frequencies from 5 Hz through 2 MHz.

2-116. The period function provides a great improvement in both accuracy and resolution of measurements made on low frequency signals. To make period measurements, the instrument measures the time interval between two consecutive cycles of a repetitive signal; Channel A is used to generate start and stop pulses. The RESOLUTION control is used to specify the value of the least significant digit (10.0 ns-1.0 ms). Use the following procedure when making period measurements:

1. Set the front panel controls as follows:

FUNCTION	- PER A
RESOLUTION	- as required, or AUTO
SEP/COM	- SEP

2. Connect the signal to be measured to the CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls (Channel A) until a stable display is seen.

2-117. Period Averaging Measurements (PER AVG A)

2-118. Multiple periods of frequencies between 5 Hz and 1 MHz may be averaged to obtain greater resolution and accuracy than with Period measurements. For example, with a Period measurement of a 1 kHz signal, the display would read "1000.00 μs"; the maximum resolution of the Least Significant Digit is 10 ns. In period Averaging, the same signal would be maximum at a display of "1000.0000 μs"; the resolution has increased to .1 ns with a sample of 100 periods (RESOLUTION control 10^2 position). Use the following procedure when making period measurements:

1. Set the front panel controls as follows:

FUNCTION	- PER AVG A
RESOLUTION	- as desired, or AUTO
SEP/COM	- SEP

2. Connect the signal to be measured to the CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls to ensure proper triggering.

2-119. Time Interval Measurements (TI A-B)

2-120. The elapsed time between events common or separate to CHANNEL A and B can be accurately measured and displayed using the Time Interval function. CHANNEL A is used to provide a start signal, and CHANNEL B provides the stop signal. Dead time is 4 μs (the counter will ignore time intervals occuring during the dead time). Use the following procedure when making time interval measurements.

1. Set front panel controls as follows:

FUNCTION	- TI A-B
RESOLUTION	- as desired, or AUTO
SEP/COM	-SEP if the start and stop signals are from separate sources. COM if the start and stop signals are from the same source.

2. For separate input signals, connect the start signal to CHANNEL A input connector and the stop signal to CHANNEL B. For common inputs, connect the signal to Channel A.

3. Use the information presented earlier in this section to ensure proper triggering.

2-121. Time Interval Averaging Measurements (TIA A-B)

2-122. Multiple time intervals can be averaged to obtain greater resolution and accuracy than with Time Interval measurements. Use the following procedure when making Time Interval Averaging measurements:

1. Set the Front Panel controls as follows:

FUNCTION	- TIA A-B
ATTENUATION	- X100
TRIGGER LEVEL	- PRESET

2. Set all other instrument controls as necessary for the application at hand.

3. For input from separate sources, connect the start signal to Channel A input terminal and set the SEP/COM switch to the SEP position. For inputs from a single source, connect the signals to the Channel A input terminal and set the SEP/COM switch to the COM position.

4. Adjust the instrument controls as described in the Operating Notes earlier in this section to insure stable display triggering at the proper points.

2-123. Totalizing Measurements (TOT A·B)

2-124. In the totalize mode, the 7261A can be used to continuously count and display the number of events occurring on Channel A during each event on Channel B. Only a reset will reinitialize the count. Use the following procedure for totalize measurements:

1. Set front panel controls as follows:

FUNCTION	- TOT A
RESOLUTION	- not used
SEP/COM	- SEP

2. Connect signal to be totalized to CHANNEL A input connector.

3. Adjust the ATTEN and TRIGGER LEVEL controls (Channel A) to ensure proper triggering.

4. Observe that the display counts up, stops, continues the count, stops, continues the count, etc.

NOTE

Should just a totalized count of Channel A input signal be desired, set the Channel A ± switch to the + position and adjust the Channel A TRIGGER LEVEL control until the + trigger status indicator goes out.

2-125. Self-Check (CHK)

2-126. The self-check function can be used to verify the digital operation of the 7261A. Each setting of the RESOLUTION control will provide a predictable display of the 10 MHz reference frequency. To self-check the 7261A, use the following procedure:

1. Press the power switch to ON.

2. Set the FUNCTION control to CHK.

3. Momentarily press the RESET control; the display should read "88888888" while RESET is depressed.

4. Set the RESOLUTION control to AUTO; the display should read "10000.00 kHz".

5. Verify correct display for each of the remaining six RESOLUTION settings as defined in Table 2-5.

Table 2-5. CHK Function Display

RESOLUTION SWITCH SETTING	DISPLAY
0.1 Hz	*0000.0000 kHz
1 Hz	10000.000 kHz
10 Hz	10000.00 kHz
100 Hz	10.0000 MHz
1 kHz	10.000 MHz
10 kHz	10.00 MHz
* Overflow annunciator should be illuminated.	

2-127. REMOTE OPERATION

2-128. The 7261A can both Talk and Listen to remote stations. The remote station programming can duplicate the use of the FUNCTION, RESOLUTION, FILT, ± (slope) and RESET, Front Panel controls. The 7261A will provide measured value data, strobes, decimal point, GATE, OVFL, and Unit's Annunciators, and command functions. The 7261A must be interfaced through the JF 1120A. The PCB installed in the 7261A is the 72XXA-521 Option which is part of the total interface 72XXA-529 Option. Detailed operation is described under these options in Section 6.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. The 7261A Universal Counter/Timer will be explained on two levels in this section. FUNCTIONAL DESCRIPTION, referenced to the functional block diagram Figure 3-1, deals with each of the 7261A's more common functions. In addition, each mode of operation will be separately described and illustrated. CIRCUIT DESCRIPTION will then provide a more specific accounting of 7261A operation; various figures present simplified schematic diagrams of these descriptions. Refer to Section 8 of this manual for detailed schematic diagrams and a list of mnemonics.

3-3. FUNCTIONAL DESCRIPTION

3-4. The 7261A Universal Counter/Timer is capable of the following measurements: frequency, period and period average, counts per minute, time interval, the time interval average, ratio, totalize A gated by B, and self check. The optional Channel C allows frequency measurement up to 520 MHz. The functional description of the instrument will consist of a basic block description followed by a description of each instrument function.

3-5. Basic Block Diagram

3-6. The major functional areas of the instrument are shown as basic blocks in Figure 3-1. Each block performs the following operations:

1. Control Logic: This block provides logic and timing functions for the 7261A. The positions of the RESOLUTION and FUNCTION controls are decoded. The decoded message signals the control logic to perform several operations: illuminate the proper decimal point and unit's annunciator, enable the correct Function and Resolution Logic, and cause the U48 to produce one of six, Resolution dependent, decade divided frequencies for control of the Main Gate. Depending on the FUNCTION selected, these frequencies are derived from the Time Base, Channel A input, or Channel B input. Control Logic also supplies autoranging for appropriate functions.

2. Signal Conditioners: These blocks condition the input signal for compatibility with other circuitry within the counter. A Signal Conditioner will provide a pulse train output, with each pulse corresponding to one cycle or event of the input signal.

3. Time Base: Depending on the FUNCTION selected, the Time Base (with dividers) supplies 10 MHz, 1 MHz or 1/6 MHz. these three frequencies are supplied by one of the available 10 MHz frequency standards or through the EXT 10 MHz input jack on the 7261A's rear panel.

4. 10-100 MHz Multiplier: This block supplies the 100 MHz clock (phase locked to the 10 MHz time base or external reference input) required by the Time Interval Average and Period Average functions and the 10 ns range for both the Period and Time Interval functions.

5. Power Supply: This block utilizes conventional power supply and regulation techniques to supply outputs of +5V to all digital circuitry, -5V to the Signal Conditioners, +12V and -12V to control circuitry. When an optional oven time base is installed, oven voltage (+5V) remains energized when the front panel power switch is placed in STBY but not when the Rear Panel REF switch is set to EXT.

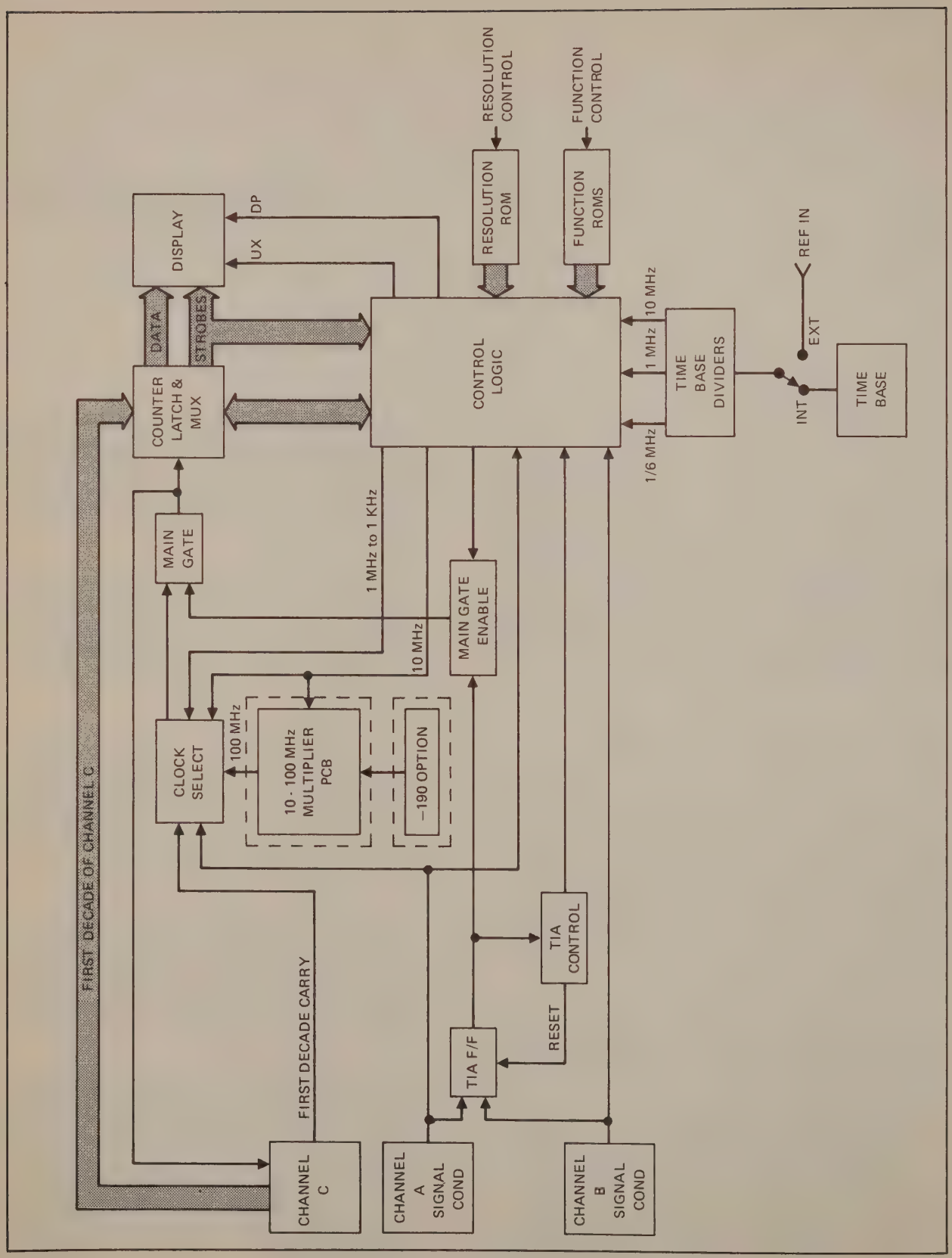


Figure 3-1. 7261A Functional Block Diagram

6. Main Gate: When enabled, the Main Gate passes pulses from the Clock Select functional block to Count and Display. Gate Select (enable) and Clock Select inputs to the Main Gate vary by function, as defined in Table 3-1.

7. Clock Select: This block routes signals to the Main Gate clock input for count and display. The Clock Select block is under direct control of signals from Control Logic.

8. Gate Select: This function enables the Main Gate for a period determined by Control Logic.

9. Count: The Count function utilizes eight counter decades and latches. An internal oscillator sequences through count, latch, and output periods to provide a BCD output to Display.

10. Display: This function provides BCD to seven segment decoding for display of the count. Decimal points and measurement units are determined by Control Logic.

11. Time Interval Flip-Flop: This function derives the start pulse from Channel A and the stop pulse from Channel B for enabling of the Main Gate.

12. Time Interval Average Control: This block receives the output pluse from the Time Interval F/F that enables the Main Gate. At the trailing edge of the Time Interval F/F pulse, this circuit will generate two pulses: a 2 μsec pulse to increase the Control Logic counter by one and a 4 μsec Reset pulse to Reset both the START and STOP portions of the Time Interval F/F.

13. Time Interval Holdoff: This circuit is an analog timer that prevents Channel B from generating the STOP pulse during TI or TIA functions for a preset length of time after the START pulse. The length of time is selected by the Front Panel TI Holdoff control.

14. CPM Control: When in the Counts Per Minute function, this functional block overrides RESOLUTION settings and routes the 1/6 MHz Time Base to Control Logic; a fixed gate time of 600 ms is established. In addition, this block disables decimal point and measurement unit outputs to the Display.

Table 3-1. Main Gate Inputs

FUNCTION	CLOCK SOURCE	GATE SOURCE
FREQ A	Channel A Input	Decade Divided Time Base from Control Logic
CPM X100A	Channel A Input	600 msec from Control Logic
FREQ C	Channel C first decade overflow	Decade Divided Time Base from Control Logic
RATIO A/B	Channel A Input	Channel B input decade divided by Control Logic
PER A	Decade Time Base from Control Logic	One period of Channel A input.
PER A 10 ns Resolution	100 MHz Time Base	
PER AVG A	100 MHz Time Base	N periods of Channel A input.
TI A-B	Decade Divided Time Base from Control Logic	Determined by TI Start and Stop Gates
TI A-B 10 ns Resolution	100 MHz Time Base	
TIA A-B	100 MHz Time Base	
TOT A-B	Channel A Input	Enable from Channel B via Control Logic
CHK	10 MHz Time Base	Decade Divided 10 MHz Time Base

3-7. Frequency (FREQ A) Measurements

3-8. When used in this mode, the 7261A will accumulate and display cycles of an input frequency for a specified length of time. This interval, known as the gate time, may be 0.1 ms, 1 ms, 10 ms, 0.1s, 1.0s, or 10s. The positioning of the decimal point, as determined by the range setting, will translate the displayed cycle count to units of kHz or MHz. For example, an input frequency of 2.3 MHz being measured on the 100 Hz RESOLUTION setting would yield a display of (2 . 3 0 0 0 MHz). The gate time, in this case 10 ms, would allow 23,000 cycles of the input frequency to be counted; the displayed number without decimal point will always equal the actual number of cycles counted during the gate time. This count would then be displayed as the input frequency by repositioning of the decimal point and illumination of the MHz units annnciator.

3-9. Frequency (FREQ A) mode is illustrated on an operational function level in Figure 3-2. Control Logic determines most other function operation. In particular, the 1 MHz reference is decade divided by Control Logic to provide the six gate times for Gate Select. Clock Select is set by Control Logic signals to route the Channel A input to the Main Gate. With the Main Gate enabled by Gate Select, the Channel A frequency will be transferred to Count and Display.

3-10. Counts per Minute (CPM X100A) Measurement

3-11. The 7261A will display revolutions per minute (RPM) when used in this mode. A 100 count per revolution transducer must be used as the input to Channel A to obtain a correct direct readout. The front panel RESOLUTION control will have no effect in this mode; the instrument will display a fixed resolution of 100 CPM. There will be no decimal point or units annunciator activated.

3-12. Counts per Minute measurement is shown on a functional level in Figure 3-3. Time Base Dividers provide a 1/6 MHz reference frequency to CPM Logic. CPM Logic performs three functions. First, the 1/6 MHz reference is routed to Program Control Logic. Secondly, CPM Logic provides a fixed range setting. Finally, decimal point placement and units annunciators are disabled. Program Control Logic decade divides the 1/6 MHz reference to 1 2/3 Hz: Gate Select thereby enables the Main Gate for 0.6 sec. Clock Select routes the input on Channel A to the Main Gate to be fed to Count and Display.

3-13. Frequency C (FREQ C) Measurement

3-14. Function of the optional Frequency C measurement is the same as the Frequency A measurement function except that there is a separate Channel C input terminal and signal conditioner. The -310 Option allows frequency measurements over the range of 50-520 MHz. This option is discussed in detail in Section 6.

3-15. Ratio (RATIO A/B) Measurement

3-16. Ratio measurement yields a numeric display, without measurement units, of the Channel A signal (5 Hz-125 MHz) divided by the Channel B signal (5 Hz-2 MHz). Refer to Figure 3-4 for the following block description. The Channel A input, always the higher frequency, is routed to the Main Gate through Clock Select. The Channel B input is decade divided within Control Logic. Depending on the RESOLUTION setting, one of six periods then enables the Main Gate through Gate Select. The number of pulses of the Channel A Signal counted during the main gate enable is then displayed without measurement unit. This displayed number is the cycle count of the Channel A signal during one period of the divided Channel B signal. With decimal point placement, this number yields the ratio between the two inputs. For example, with 5 MHz on Channel A, 500 kHz on Channel B and a RESOLUTION setting of 10^1, the Main Gate will be enabled for 20 μs. During this time, 100 cycles of the Channel A frequency will be counted, and the display will yield a reading of "10.0".

3-17. Period (PER A) Measurements

3-18. The period of the Channel A input signal is measured by counting a reference frequency for an interval determined by the input signal. Depending on the RESOLUTION setting, the 7261A will count a reference frequency of 100 MHz, 10 MHz, 1 MHz, 100 kHz, 10 kHz, or 1 kHz. The display will then show the total count of the reference frequency for the period of one cycle of the input frequency. With repositioning of the decimal point and illumination of the "μsec", "msec" or "sec" units annunciator, this count will identify the period of one Channel A input cycle. For example, with a Channel A input frequency of 400 kHz set for PER A measurement with 100 ns RESOLUTION, the 7261A will count a 10 MHz reference frequency for 2.5 μs. A count of 25 will be accumulated and displayed. the RESOLUTION setting will also specify the decimal point and measurement unit for the display; a reading of (0 . 0 0 2 5 ms) will be displayed. The total count of the reference frequency is thereby displayed.

3-19. Period measurement is functionally illustrated in Figure 3-5. The Channel A input frequency is used as the Clock Input to U48. Control Logic U48 uses the Channel A input frequency to provide one time period of the Channel A input to the main Gate select circuit. RESOLUTION control positioning determines the time

base frequency applied to the Main Gate. The Clock Select circuitry will apply the 100 MHz clock frequency from the 10-100 MHz Multiplier PCB to the Main Gate clock input when the RESOLUTION control is in the 10 nsec position. When the RESOLUTION control is in any other position, the Clock Select circuitry will apply appropriate decade divided time base to the Main Gate clock input. The frequency applied to the Main Gate clock input will be fed to the Count and Display whenever the Main Gate is enabled.

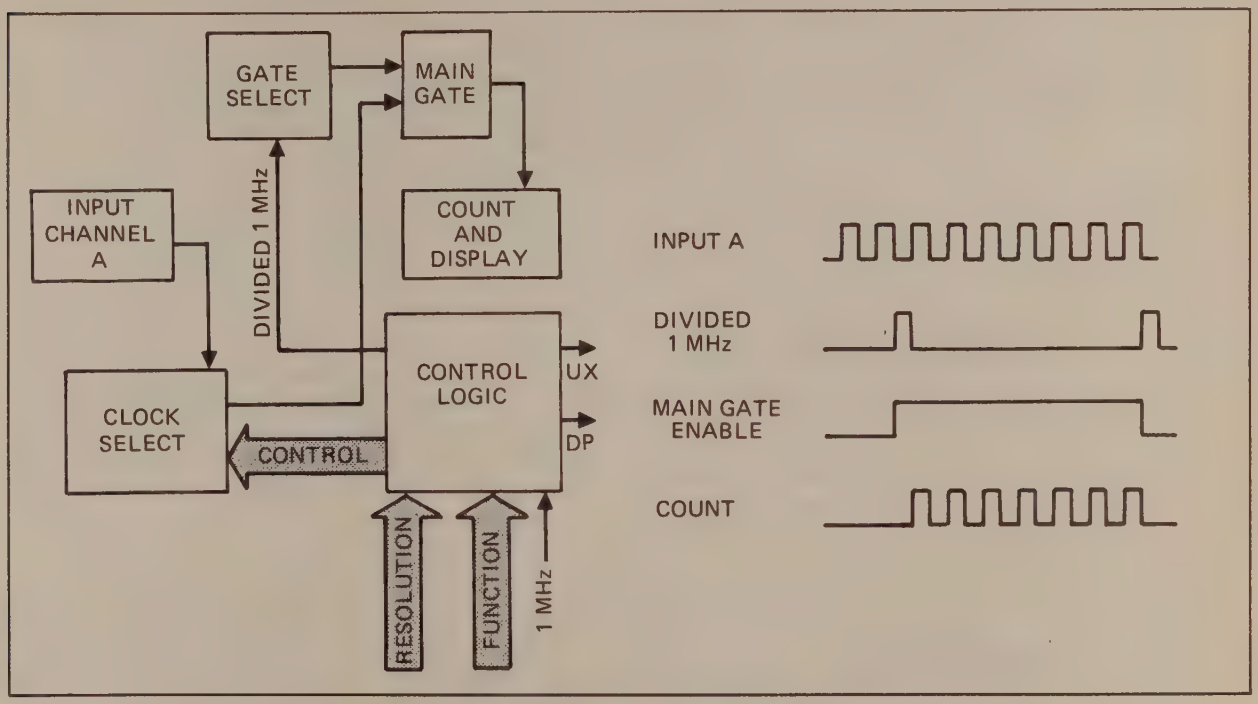


Figure 3-2. Frequency Measurement

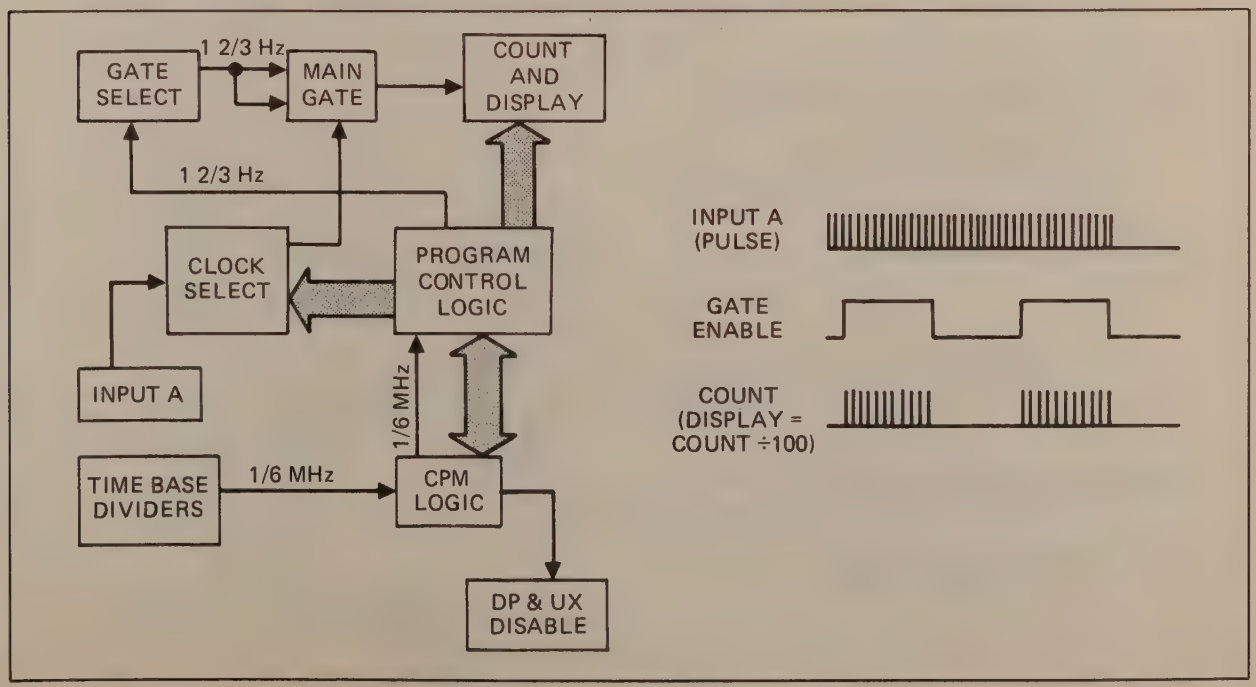


Figure 3-3. Counts Per Minute Measurements

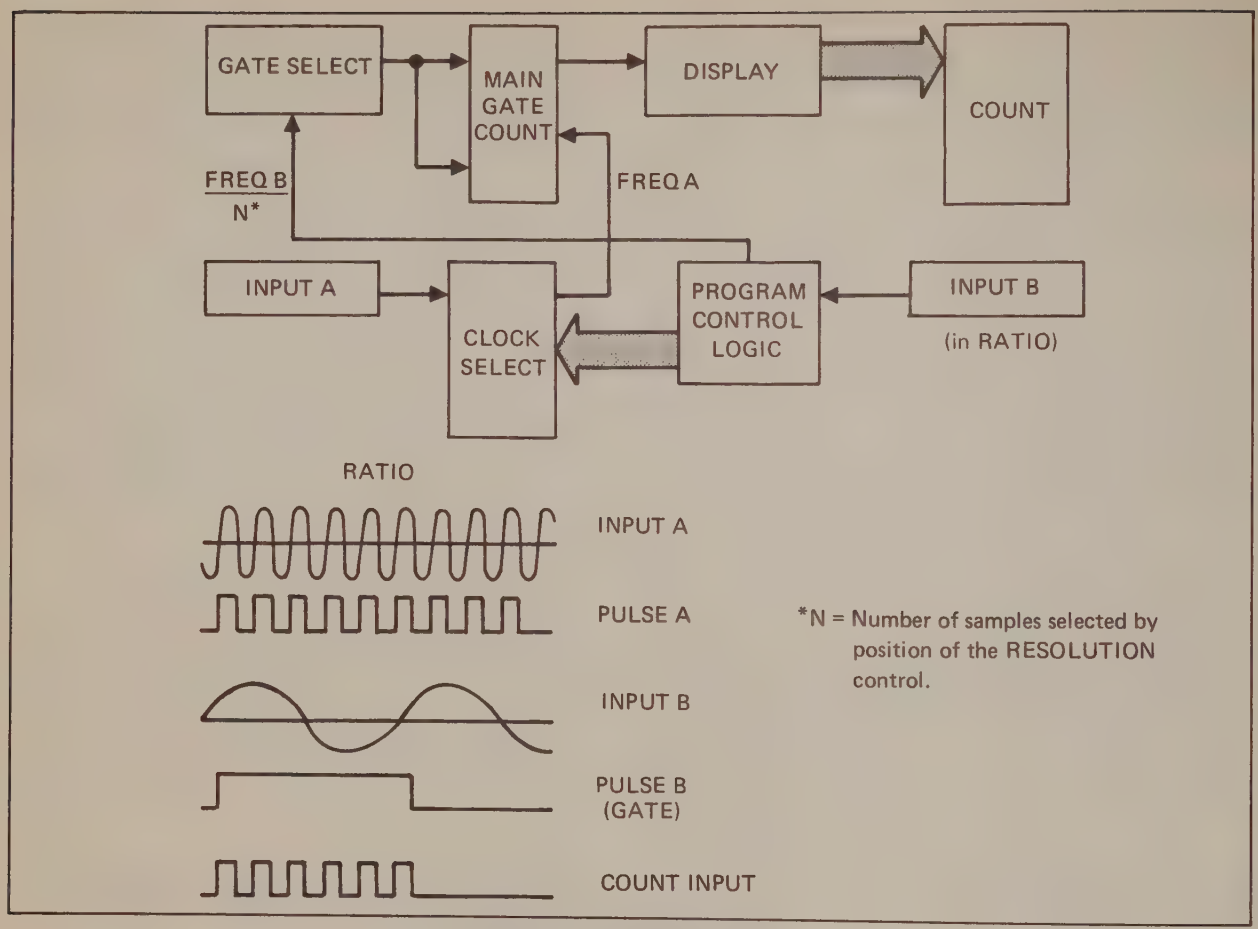


Figure 3-4. Ratio Measurements

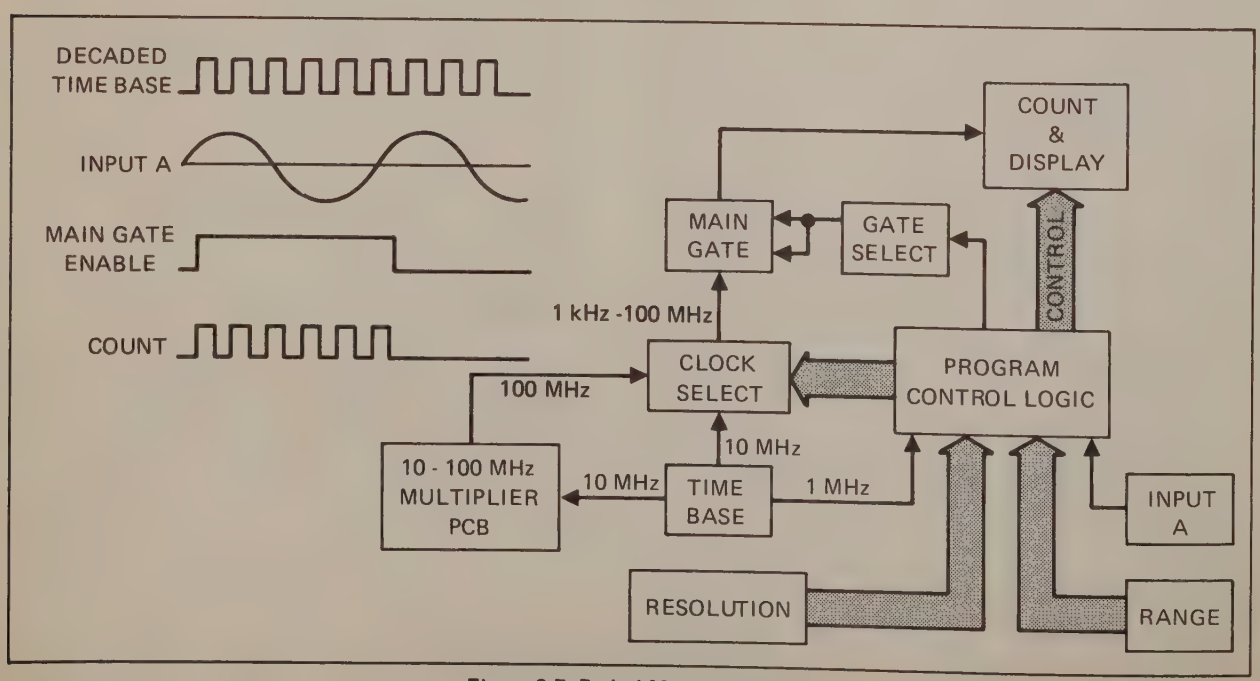


Figure 3-5. Period Measurements

3-20. Period Averaging (PER AVG A) Measurement

3-21. During period averaging measurements, the 7261A will count a reference frequency for an interval equal to multiple cycles of the Channel A input frequency. The Front Panel RESOLUTION control will determine the number of input cycles during which the reference frequency is counted (10^0 - 10^5 input cycles in decade steps). The reference frequency will now be the 100 MHz signal from the 10-100 MHz Multiplier PCB. As in period measurements, the decimal point and units annunciator will be utilized to display the average elapsed time for one period of the Channel A input frequency. As an example, a 400 kHz Channel A input signal could be measured with the RESOLUTION control set to "10^3". The 100 MHz reference frequency will now be counted for 1000 cycles of the input signal: 250,000 counts will be displayed. The decimal point and units annunciator will specify the display to read (2 . 5 0 0 0 0 μs). The display's resolution is thereby greatly enhanced. A resolution of 10 ps is shown in Period Average, whereas the same signal exhibited only 100 ns resolution in the Period measurement example.

3-22. An illustrated functional approach to Period Average measurement is provided in Figure 3-6. Program Control Logic enables Clock Select to apply the 100 MHz to the Main Gate. The input frequency (Input A) is decade divided by Program Control Logic; depending on the RESOLUTION setting, the Channel A frequency or one of five derived frequencies is applied to Gate Select. The Main Gate is thereby enabled for an interval equal to 10^0 to 10^5 cycles of the Channel A input. When enabled, the Main Gate feeds the 100 MHz reference to Count and Display. Program Control Logic then determines display update, decimal point placement and units annunciation.

3-23. Time Interval (T.I. A-B) Measurements

3-24. For time interval measurements, the 7261A will display counts of a scaled reference frequency for a period whose start is determined by the Channel A input signal and whose stop is determined by the Channel B signal. Refer to Figure 3-7 during the following block diagram discussion. One of six reference frequencies is selected by the RESOLUTION Control for routing through Clock Select to the Main Gate. These frequencies are the 100 MHz or 10 MHz time base and four derived frequencies (1 MHz-1 kHz) from Control Logic. Gate Select is held enabled by Control Logic, allowing the Time Interval Flip-Flop to control the Main Gate. Depending on the Slope Control setting, a positive or negative going Channel A input will now enable the Main Gate to pass the reference frequency. Under similar control, the Channel B signal will disable the Main Gate. The accumulated counts of the reference frequency between A and B inputs are displayed as in Period measurements.

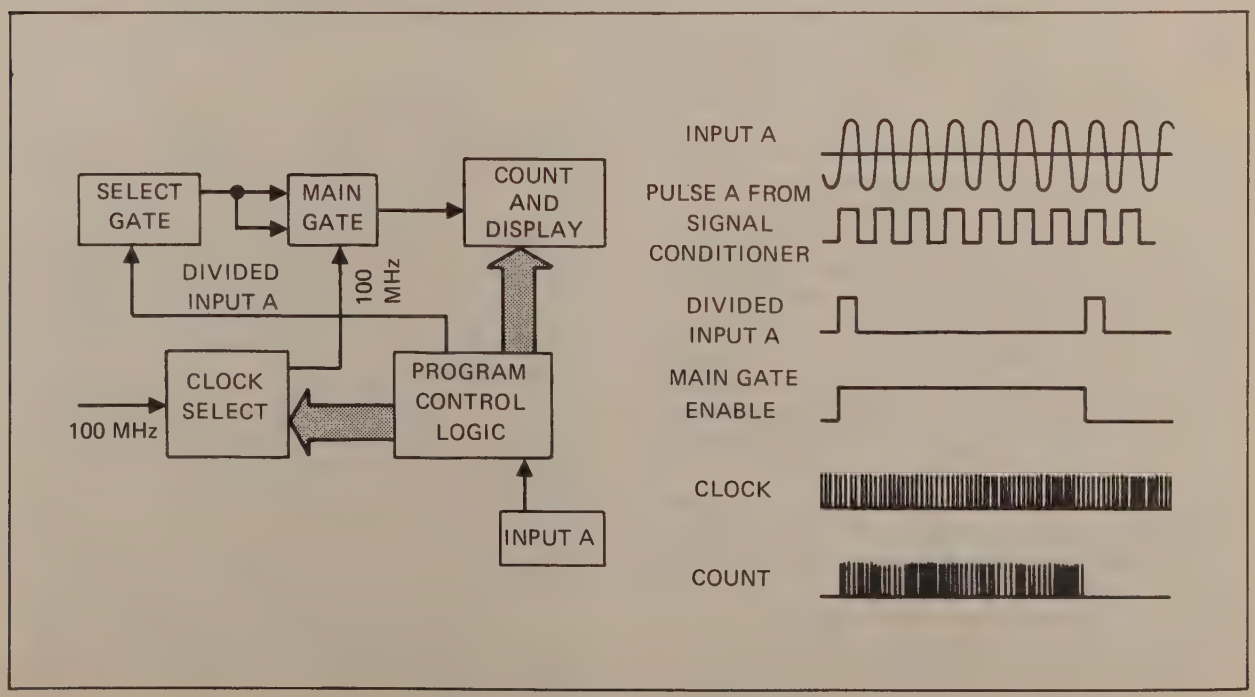


Figure 3-6. Period Average Measurements

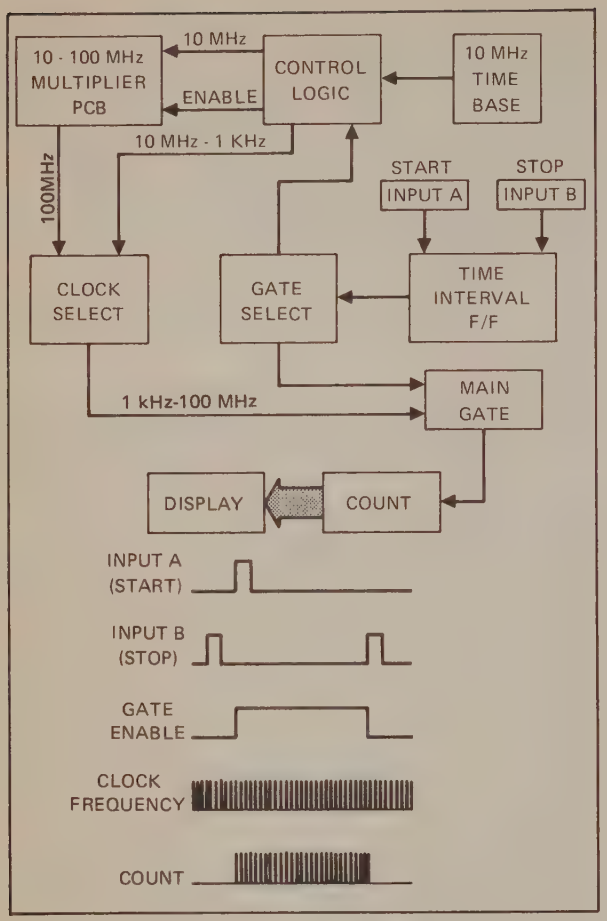


Figure 3-7. Time Interval Measurements

3-25. Time Interval Average (TIA A-B) Measurements

3-26. For time interval average measurements, the 7261A will display the average number of counts of the 100 MHz clock that occur during each period of a repetitive signal. To find this average number, the total count that occurs during N periods is divided by N. The Front Panel RESOLUTION control will determine N, the number of time intervals averaged (10^0 - 10^5 intervals). The reference frequency counted will be the 100 MHz signal from the 10-100 MHz Multiplier PCB. This 100 MHz signal is phase locked to the 10 MHz clock. The decimal point and units annunciators will be utilized to display the average time interval measured. For example: With two input frequencies with a time interval of 1.5 μsec at a repetition rate of 100 kHz, set the RESOLUTION control to the 10^2 position. The instrument will count 150 cycles of clock frequency during each time interval for 100 intervals. The total count will be 15,000. The display will show 1.5000 μsec. Using the resolution formula in Table 1-2, resolution possible on this range using the TIA function is .1 ns maximum. Resolution of the Time Interval function is only 10 ns. Resolution has been enhanced 100 times.

3-27. Figure 3-8 is a simplified function diagram of the time interval average function. At the beginning of a measurement cycle, the Control Logic enables the Gate Select circuitry so that the Time Interval F/F controls the Main Gate. The Control Logic also routes the 10 MHz signal from the time base to the 10-100 MHz Multiplier PCB. This places a precision 100 MHz reference frequency on the clock input of the Main Gate. (The 100 MHz signal is phase locked to the precision 10 MHz signal so instrument accuracy remains unchanged.)

3-28. As in time interval measurements, the START pulse is generated through Channel A. This signal will pass through the Gate Select circuit and open the Main Gate. The Counter will begin to accumulate 100 MHz pulses. At some later time, the input to Channel B will generate the STOP pulse. This pulse will cause the Time Interval F/F to open the Main Gate. The Count circuitry begins to accumulate pulses of the 100 MHz signal. At some later time, the STOP pulse causes the Time Interval F/F to close the Main Gate. The Count now holds the total number of cycles of the 100 MHz signal that occurred during the time interval. This measurement sub-cycle will continue until the Control Logic remove the enable signal from the Gate Select circuitry.

3-29. The signal from the Time Interval F/F that opened and closed the Main Gate also goes to the Time Interval Average Control circuit. The leading edge of the STOP pulses causes the Time Interval Average Control circuit to simultaneously begin two pulses: a 2 usec pulse to the Control Logic clock input and a 4 usec Reset pulse to the Stop and Start gates. The 2 usec pulse increments a counter in the Control Logic once each time interval. After N (the number of time intervals selected by the RESOLUTION control) time interval counts have been accumulated in the counter, the Control Logic causes the average time interval value to be displayed. This average time interval value is the total accumulated count of clock pulses that occurred during all of the time intervals measured, divided by the number of time intervals measured. Since the number of time intervals is always a power-of-ten, the division is accomplished by moving the decimal point position. The 4 usec pulse from the Time Interval Average Control circuit holds the STOP and START gates OFF. Thus the time intervals measured may not be consecutive.

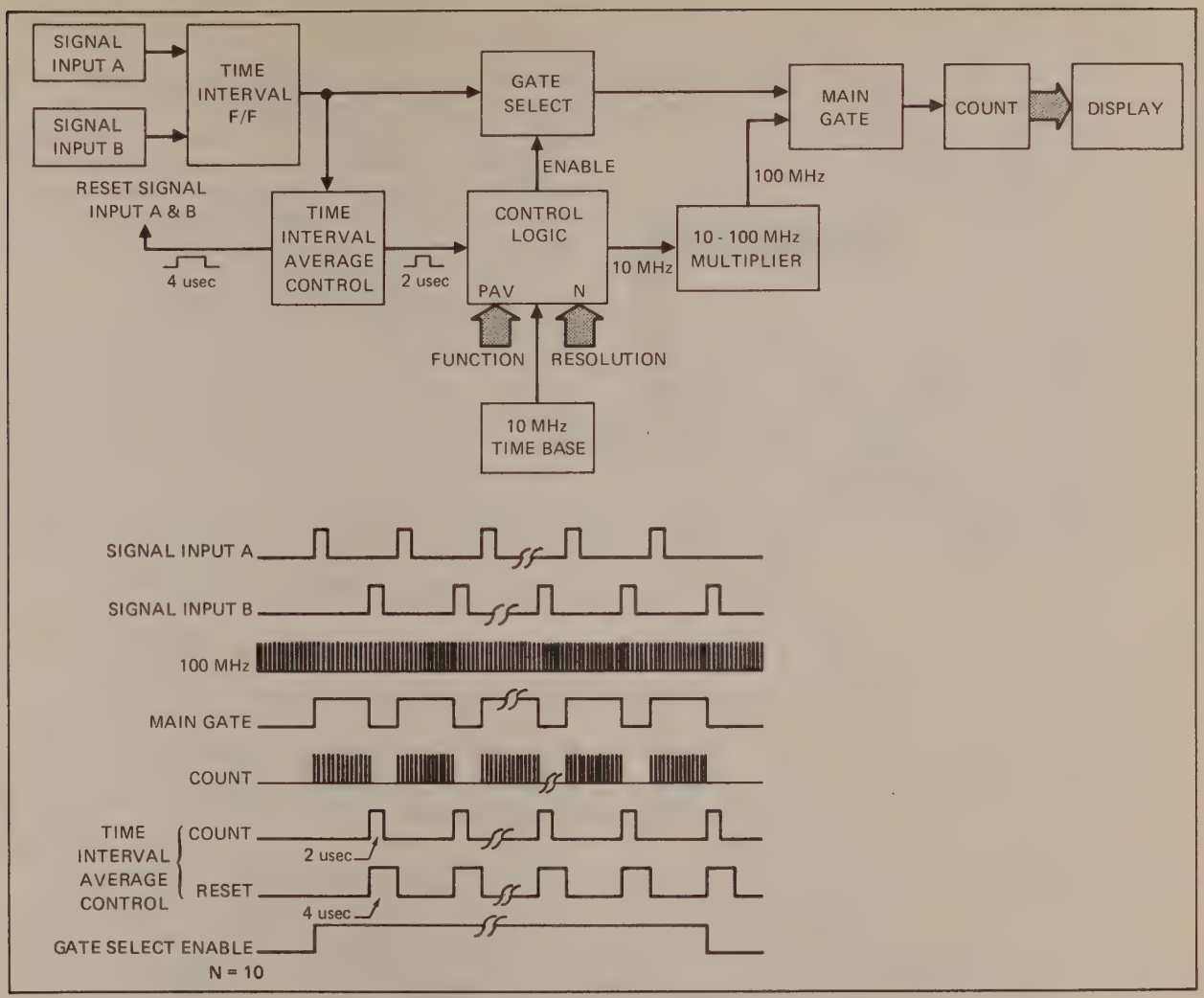


Figure 3-8. Time Interval Average A-B Measurements

3-30. Totalize A Gated by B (TOT A·B) Measurement

3-31. During totalize measurements, the outputs of the Channel A and Channel B signal conditioners are ANDed then counted. The number displayed represents a continuing total number of triggering events that occur on Channel A when an event ocurs on Channel B. The 7261A will restart this count only when a reset is applied. No measurement units or decimal points are used during totalize measurements. Refer to Figure 3-9 for the following functional block description. A constant Main gate enable is supplied from Control Logic through Gate Select. The pulses resulting from ANDing Channel A with Channel B clock the Main Gate and are displayed to a maximum count of "99999999".

3-32. Self-Check (CHK) Measurement

3-33. In the self check mode, the 10 MHz reference frequency is used as a dynamic verification of counter digital circuitry operation. Input and signal conditioning circuitry nor time base accuracy cannot be checked in this function. Each setting of the RESOLUTION control yields a predetermined display readout as defined in Table 3-2. Refer to Figure 3-10 during the following block description. Control Logic disables inputs from the Channel A Signal Conditioner while providing digital control for Clock Select, Gate Select, Count and Display functional blocks. Clock Select routes 10 MHz from the Time Base to the Main Gate. Depending on the RESOLUTION setting, Gate Select enables the Main Gate for a duration derived from the 10 MHz reference in Control Logic. The 10 MHz Clock Select frequency is thus counted and displayed for gate times of 0.1 ms to 10s. Overflow indication will occur at the 1 Hz and 0.1 Hz settings.

3-34. CIRCUIT ANALYSIS

3-35. The following descriptions detail key circuit operation in the 7261A. Circuit descriptions for options

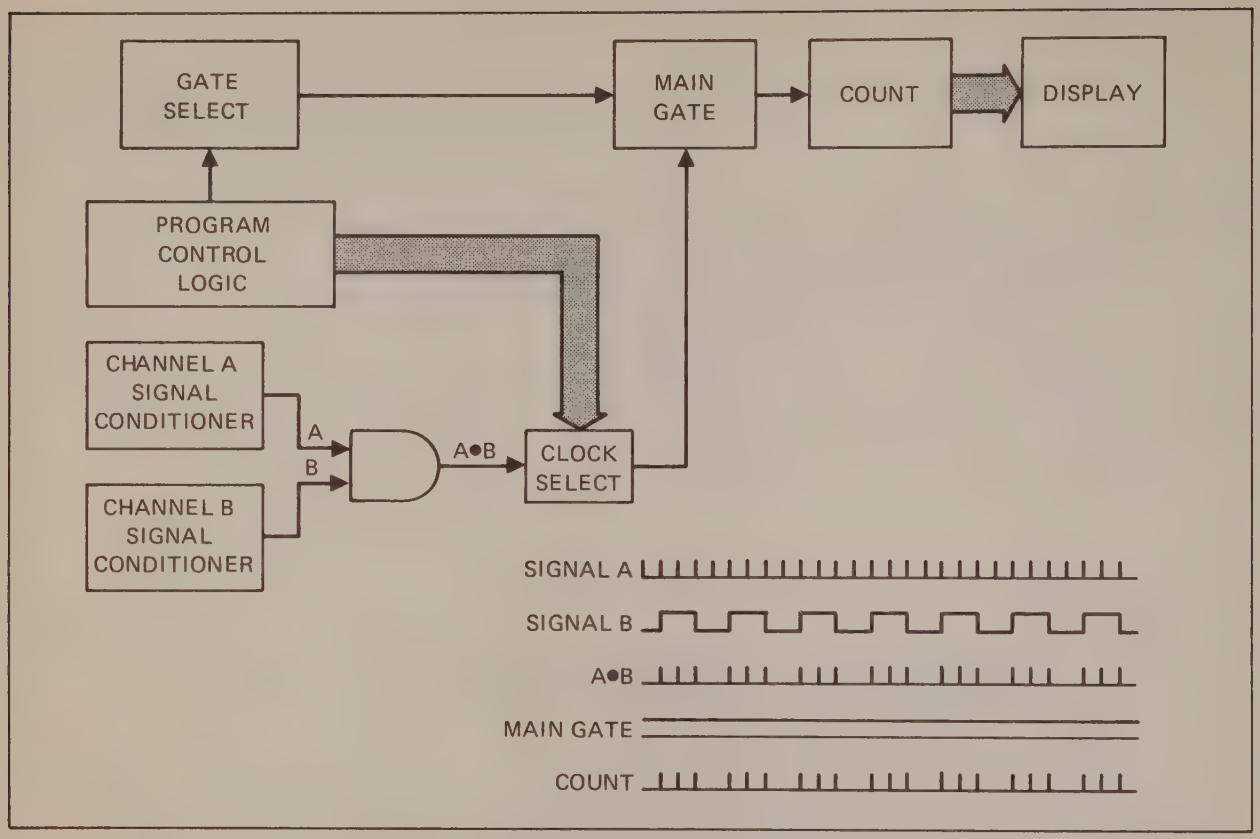


Figure 3-9. Totalized A Gated by B Measurements

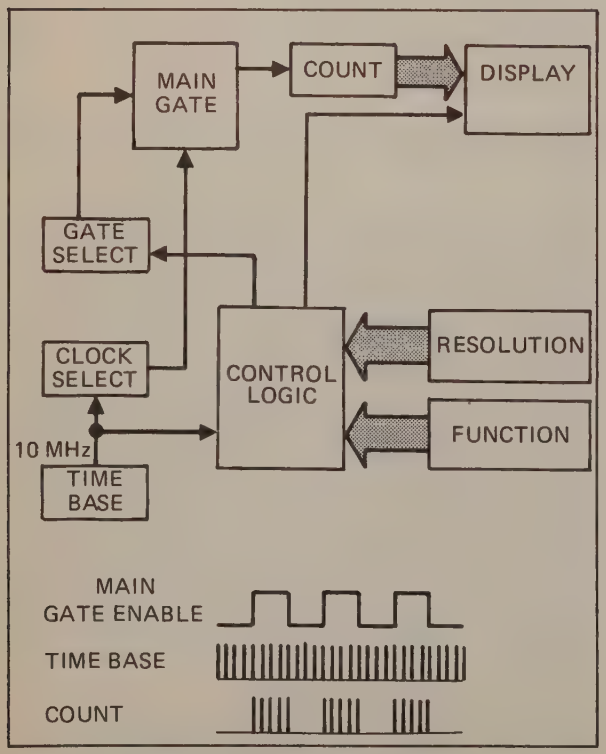


Figure 3-10. Self Check Function

Table 3-2. U17 Output Versus Instrument Function

FUNCTION	Y OUTPUT TERM
FREQ A	$\overline{GQ}$
CPM X100A	$\overline{GQ}$
FREQ C	$\overline{GQ}$
RATIO A/B	$\overline{GQ}$
PER A	$\overline{GQ}$
PER AVG A	$\overline{GQ}$
TI A-B	TIA F/F
TIA A-B	TIA F/F
TOT A·B	$\overline{EA}$ (CH A·CH B)
CHK	$\overline{GQ}$

are presented in Section 6 of this manual. It is recommended that the FUNCTIONAL DESCRIPTION be read first for an overall understanding of the instrument. The simplified schematic diagrams presented here are referenced in the applicable paragraphs. Complete schematic diagrams and mnemonic definitions will be found in Section 8.

3-36. Power Supply

3-37. The 7261A Power Supply utilizes standard ac to dc rectifying, filtering and regulating circuitry to provide regulated outputs of –5V, +5V, –12V, and +12V. Accomodation to line voltages of 100V, 120V, 220V, or 240V is achieved through positioning of S4 and S5 in the power transformer's primary. The +5V is supplied by tracking regulator U25 which tracks the +12 volts. The –5V is supplied by tracking regulator U24 which tracks the 5 volts. The use of tracking regulators rather than conventional regulators greatly reduces the effects of internal instrument noise on the instrument operation. The Rear Panel ON-OFF switch removes line voltage from the primary of the power supply transformer. The Front Panel ON/STBY switch (S3) disconnects the regulated voltages from 7261A circuitry; the STBY position will maintain +5V to any installed oven option if the Rear Panel REF switch is at the INT position. If the -010 Battery Option is installed, refer to Section 6 for discussion of the LINE/BAT switch.

3-38. Time Base

3-39. The 10 MHz reference is supplied by an internal free air time base, an optional internal time base, or by an external time base applied through the rear panel connector. Amplifier Q8 provides a 10 MHz TTL output from whichever time base is selected. This reference is divided by counter U26-3, providing a 1 MHz signal to Control Logic input CI (U13-12). This reference is passed by selector U2-4 to the CI input of U48 whenever CPM mode is not selected. The 1 MHz signal from U26-3 is also decade divided by U26-13 to provide 100 kHz for the gate synchronizer U21-9. Divide-by-six counter U38-14 uses the 1 MHz signal to derive a 1/6 MHz reference to be used for CPM measurements. Further decade division of the 1 MHz or 1/6 MHz (in CPM) reference occurs within Control Logic. The rear panel EXT-INT switch must be placed to EXT when an external time base is applied through the rear panel connector. With the switch in EXT, power is removed from the internal time base; if an oven option is installed, the oven will cool.

3-40. Input Circuitry

3-41. Identical input circuitry is utilized for Channel A and Channel B. For either Channel, the input signal is amplified, filtered, and shaped to provide an output at ECL logic levels. Figure 3-11 illustrates input circuitry for either channel. Each input is fuse protected (for 250V rms or 250 mA) and may be either AC or DC coupled to the three position attenuator. The attenuator provides three attenuation factors: X1, X10 and X100. At the output of the attenuator network, the Channel A and Channel B input circuits may be tied together through the SEP/COM switch.

3-42. Within the Signal Conditioner, the signal passes two clamping diodes and an input buffer prior to entering the Preamplifier IC. The preamplifier IC contains an amplifier, a Schmitt Trigger for signal shaping, and an ECL driver. Trigger Level is selected by changing the negative input to the Input amplifier. If the Front Panel TRIGGER LEVEL control is in the PRESET position, a fixed trigger voltage is selected (this fixed voltage can be adjusted during the calibration adjustments in Section 4). Any other setting of the Front Panel TRIGGER LEVEL control varies the reference voltage of the negative input to the Input Amplifier, varying the offset of the amplifier. This in turn will continuously adjust the trigger point between +1.5V and –1.5V. The hysteresis window of the

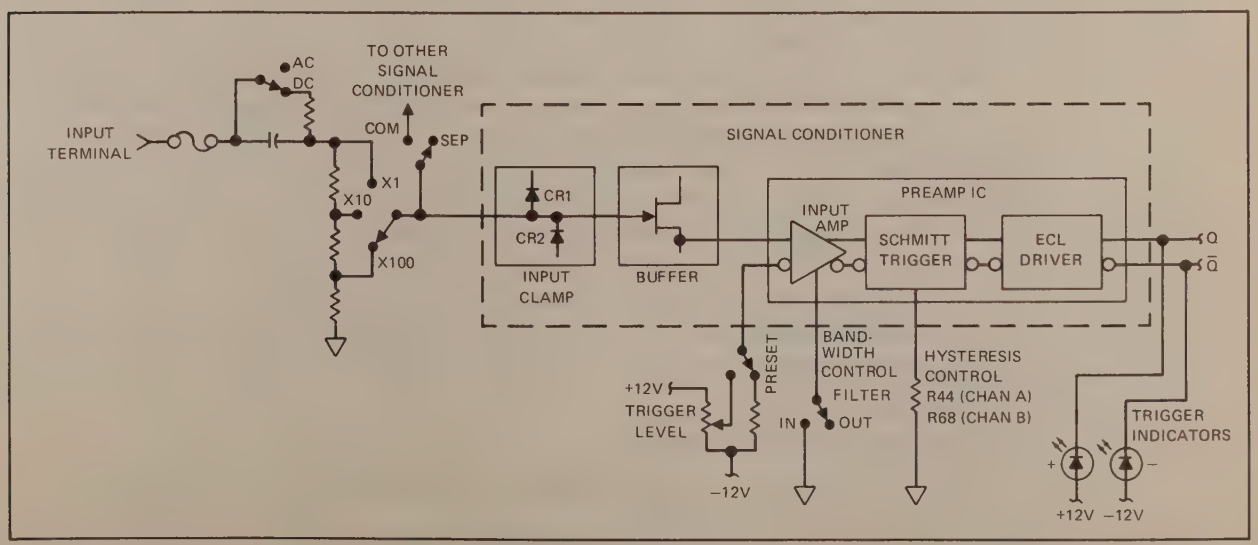


Figure 3-11. Input Circuit

Schmitt trigger is permanently selected by the hysteresis resistor located on the Main PCB. The bandpass of the Input Amplifier can be reduced from 0-125 MHz to 0-100 kHz by placing the FILTER control at the IN position. This is effectively the same as placing a low pass filter in series with the input but does not distort the input signal. The Q and $\overline{Q}$ ECL outputs go to the Main PCB for processing and to the Front Panel to drive the ± trigger status indicator circuitry.

3-43. Function Logic

3-44. The measurement function that the instrument is set up to make is determined by the coding on five data lines: F1, F2, F4, F8 and A5 (RØ). The state of F1 through F8 is determined either by the position of the Front Panel FUNCTION control through P1 or remote programming through P4. U45 determines whether function control is local or remote. A5 (RØ) is generated by U31 when the lines R1, R2, And R4 are all zero. The levels on these lines can be remote programmed or determined by the position of the Front Panel RESOLUTION control. Again, U45 determines whether local or remote programming controls the data lines. R1, R2 and R4 all zero corresponds with the 10° position of the Front Panel RESOLUTION control.

3-45. The five data lines control multiplexer U17, and are the inputs to ROMs U41 and U42. U17 determines which of its various inputs will control the GATE annunciator on the Front Panel Display and determine which signal is routed to the GATE status of the remote interface (via P4). Table 3-3 lists the U17 input used for each instrument function. ROMs U41 and U42 decode the five data lines to determine the routing of Clock Select, Gate Select, Time Base Signal, turn on or off the 10-100 MHz Multiplier PCB, turn on and off the Time Interval, Time Interval Average, and Counts Per Minute circuitry external to the Program Logic IC, U48. Table 3-4 lists the outputs of the ROMs and gives a brief description of what each output does. Detailed instrument coding for these three ICs can be found in Table 3-5. Each change of the FUNCTION switch setting will generate an instrument RESET pulse.

Table 3-3. Function ROM's Outputs

ROM	OUTPUT	FUNCTION
U41	B0 B1*	When the TI A-B or TIA A-B function is selected, enables the Time Interval and Time Interval Averaging circuitry external to U48.
	B2	When the CPM X100A function is selected, does these things: 1. Gates U2 so that U2-6 is 1/6 MHz instead of 1 MHz. This frequency goes two places: first, it is the CI (clock input) of program logic chip U48; second, it is the input to U2-13. 2. Controls Resolution ROM U43 so that the one range is used when the CPM X100A function is selected. (Resolution control has no effect.) 3. Disables the Units Annunciation Muliplexer U40 so that no Units Annunciator is illuminated.
	B3	When the PER AVG A or RATIO A/B function is selected and the RESOLUTION control is in any but the 10^0 (RØ) position. This output inhibits the clock to U19, holding the Main Gate open until the number of occurences selected by the RESOLUTION control have occurred. When the 10^0 position of the RESOLUTION control is selected, only 1 occurrence is to be measured so there is no need to inhibit the clock to U19.
	B4	Provides the A5 input for the Resolution ROM. This data line is at a 1 level when either PER A or TI A-B function is selected.
	B5*	When either the PER A or TI A-B function is selected and the RESOLUTION control is in the 10^0 position, this line drives the Units Annunciation Multiplexer to illuminate the μsec Units Annunciator.
	B6	When either the TI A-B or TIA A-B function and 10° Resolution are selected, this output forces the D input to U7 to a logic "1".
	B7	When CPM X 100, FREQ A, FREQ C, TIA-B or TIA A-B is selected, this line goes true to control gate synchronizer U21-9.

* Negative True Output

Table 3-3. Function ROM's Outputs (cont)

ROM	OUTPUT	FUNCTION
U42	B0 B1 B2	M1 M2 M3 } Coded input lines to the program logic IC U48. These lines determine the mode of operation of the IC.
	B3 B4*	When the FREQ C function is selected with one of the Frequency C options installed, these two lines turn on the Frequency C PCB, disable the Channel A input to the Main PCB, turn off the Channels A and B signal conditioners and route the Channel C input in its place.
	B5	If the -190 Jittered Time Base Option is installed and the TIA A-B function is selected, this data line enables the output of the Jittered Time Base PCB.
	B6*	When either the TIA A-B or PER AVG A function or when the RESOLUTION control is in the 10^0 position during either the PER A or TI A-B function, this data line disables the other inputs to the Main Gate and replaces it with the 100 MHz clock from the 10-100 MHz Multiplier PCB.
	B7	When either the PER AVG A or TIA A-B function is selected, this line drives the Decimal Point Multiplexer U32 to shift the decimal point in the Display to the proper place.
		* Negative True Output

Table 3-4. Instrument Function Coding

FUNCTION	U41 and U42 INPUTS					U41 OUTPUTS								U42 OUTPUTS								U17		
																						CONTROL INPUTS		Y OUTPUT USES INPUT
	F1	F2	F4	F8	A5	B0	B1	B2	B3	B4	B5	B6	B7	B0	B1	B2	B3	B4	B5	B6	B7	U41 F8	U41 F4	U41 B1
FREQ A	0	0	0	0	X	0	1	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1	D4
CPM X100A	0	0	0	1	X	0	1	1	0	0	1	0	1	0	0	0	0	1	0	1	0	1	0	1	D5
FREQ C	0	1	1	0	X	0	1	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	1	1	D6
RATIO A/B	1	0	0	0	X	0	1	0	Y	0	1	0	0	1	0	0	0	1	0	1	0	0	0	1	D4
PER A	0	1	0	0	X	0	1	0	0	1	Y	0	0	0	1	0	0	1	0	Y	0	0	0	1	D4
PER AVG A	1	1	0	0	X	0	1	0	Y	0	1	0	0	1	1	0	0	1	0	0	1	0	0	1	D4
TI A-B	0	0	1	0	X	1	0	0	0	1	Y	1	1	0	0	1	0	1	0	Y	0	0	1	0	D2
TIA A-B	1	0	1	0	X	1	0	0	0	0	1	X	1	1	1	0	0	1	1	0	1	0	1	0	D2
TOT A-B	0	1	1	1	X	0	1	0	0	0	1	0	0	0	1	1	0	1	0	1	0	1	1	1	D7
CHK	1	1	1	0	X	0	1	0	0	0	1	0	0	1	1	1	0	1	0	1	0	0	1	1	D6

If	R0	1	0
Then	X	1	0
	Y	0	1

Where RO is a logic "1" in the 10^0 RESOLUTION setting and a logic "O" in all other RESOLUTION SETTINGS.

X and Y are variables depending upon the state of RO.

U17 INPUT	SIGNAL
D2	TI Gate
D4, D5, D6	Gate
D7	CH A-CH B

Table 3-5. Instrument Resolution Coding

RESOLUTION SWITCH SETTINGS	RESOLUTION ROM U43							
	INPUTS					OUTPUTS (U48 INPUTS)		
	R1	R2	R4	CPM	PAV +TI	R1	R2	R3
10^0	0	0	0	0	0	0	0	0
10^1	1	0	0	0	0	1	0	0
10^2	0	1	0	0	0	0	1	0
10^3	1	1	0	0	0	1	1	0
10^4	0	0	1	0	0	0	0	1
10^5	1	0	1	0	0	1	0	1
AUTO	1	1	1	0	0	1	1	1
10^0	0	0	0	1	0	1	1	0
10^1	1	0	0	1	0	1	1	0
10^2	0	1	0	1	0	1	1	0
10^3	1	1	0	1	0	1	1	0
10^4	0	0	1	1	0	1	1	0
10^5	1	0	1	1	0	1	1	0
AUTO	1	1	1	1	0	1	1	0
10^0	0	0	0	0	1	1	0	1
10^1	1	0	0	0	1	0	0	0
10^2	0	1	0	0	1	1	0	0
10^3	1	1	0	0	1	0	1	0
10^4	0	0	1	0	1	1	1	0
10^5	1	0	1	0	1	0	0	1
AUTO	1	1	1	0	1	1	1	1

3-46. Resolution Logic

3-47. The R1, R2 and R3 input data lines to the Control Logic IC, U48, determine the operational range of the instrument. With a few exceptions, U48 positions the decimal point and illuminates units annunciators appropriate to the range of operation selected. The levels on the three data lines are coded by the Resolution ROM, U43, to form the five inputs to U43: R1, R2, R4, CPM, and PA+TI. The levels on R1, R2 and R4 may be determined by either the position of the Front Panel RESOLUTION control or the remote programming interface. Multiplexer U45 determines whether control of these three data lines is local or remote. The level on the CPM input line is determined by U41-B2. This line will only affect the output of the Resolution Multiplexer when the CPM X100A function is selected. The level on the PA+TI input line is determined by U41-B4. This line will only affect the output coding of the Resolution Multiplexer if either the PER A or TI A-B function is selected. Table 3-6 details the instrument resolution coding.

3-48. As stated in the paragraph above, U48 control decimal point location and units annunciation selection with three exceptions:

1. When the CPM X100A function is selected, the CPM signal from U41-B2 passes through inverter U12. This $\overline{\text{CPM}}$ signal will inhibit both the Decimal Point Mutliplexer, U32, and the Units Annunciator Multiplexer, U40, so that there will be no decimal point displayed or units annunciator iluminated regardless of the position of the Front Panel RESOLUTION control.

2. When either the PER A or TI A-B function is selected and the RESOLUTION control is in the 10° position, the $\overline{(\text{PA} + \text{TI})\ \text{R}\emptyset}$ term from U41-B5 will force the Units Annunciator Multiplexer, U40, to illuminate the usec annunciator.

3. When either the PER AVG A or TIA A-B Function is selected, U42-B7 will command the Decimal Point Multiplexer, U32, to position the decimal point one place to the left, on the display, for each position of the RESOLUTION control.

Table 3-6. Control Logic U48 Pin Description

PIN	MNEMONIC	DESCRIPTION
1	Vss	+5V
2	D1	Input, Strobe Line DS2
3	D2	Input, DS3
4	D3	Input, DS4
5	DP	Output, decimal point multiplexed to strobe lines.
6	UX	Output, units annunciator multiplexed from FUNCTION and RESOLUTION settings.
7	RI	Input, reset.
8	D4	Input, DS5
9	D5	Input, DS6
10	D6	Input, DS7
11	V_{DD}	−12V
12	CI	Input, 1 MHz (1/6 MHz in CPM mode)
13	P2	Prescale control bits (used with prescaled FREQ C options)
14	P1	
15	XB	Input, from Channel B Signal Conditioner. Used in RATIO A/B
16	XA	Input, from Channel A Signal Conditioner. Used in PER, PER AVG A
17	EA	Output, LO for TI A-B and CHK
18	TE	Output, HI for TI A-B
19	M1	Inputs, FUNCTION lines from Function Control ROM.
20	M2	
21	M3	
22	R1	Inputs, RESOLUTION lines from Resolution ROM.
23	R2	
24	R3	
25	EH	Output, enables 10 MHz clock for CHK (all resolutions) and TI A-B or PER (100 ns resolution only).
26	$\overline{GR}$	Output, resets Main Gate Flip-Flop and sets Time Interval start flip-flop
27	$\overline{GS}$	Output, sets Main Gate Flip-Flop, stays high in CHK and TOT A.
28	CO	Output, from decades in PER, TI A-B or CHK
29	V_{GG}	0V
30	ST	Input, start from remote
31	SC	Input, single or continuous counts from remote
32	$\overline{M}$	Output, memory update to counter-multiplexer U15
33	BY	Output, Busy (high) when a measurement sequence in process
34	CR	Cycle Rate RC setting
35	$\overline{R}$	Output, resets decade counters
36	AR	Input, autorange feedback from counter-multiplexer U15
37	TQ	Input, from Time Interval stop flip-flop at end of measurement
38	GQ	Input, from output of Main Gate Flip-Flop
39	AO	Input, autorange feedback from overflow flip-flop in counter-mulitplexer U15
40	GC	Output, clocks Main Gate Flip-Flop

3-49. When the Front Panel RESOLUTION control is in the AUTO position (for any function except CPM X100A or TOT A B) autoranging is enabled. When either the PER A or TI A B function is selected, the Control Logic can autorange through three resolution ranges (10 μs, 1 μs, 100 ns). When any other autoranging function is selected, the Control Logic can autorange through the first five ranges of resolution (10^0, 10^1, 10^2, 10^3, 10^4). The Control Logic will sequence through its available ranges to obtain the range that allows an in range measurement with maximum resolution. To do this, the Control Logic starts with the 10^0 resolution range and measures the unknown input signal to the instrument. If the measurement is in range, the MSD of the measured value will be in the sixth, seventh or eighth (MSD) digit of the Counter, U15. The sixth digit of the Counter will have generated an overflow. This overflow is the autorange return (AR) input to the Control Logic IC, U48. The Control Logic will sequence through the ranges until it receives this AR input or until the sequence reaches the highest range. The Control Logic will allow the instrument to display the measured value of the unknown input signal. During autoranging, the decimal point and units annunciator circuitry is kept from changing. When autoranging stops, decimal point and units annunciation change to the last range used in the autoranging process.

3-50. When the reading is only marginally best resolved in one setting, or is varying slightly, an unnecessary shift in resolution will be prevented by a hysteresis circuit in Control Logic (U48). The hysteresis flip-flop becomes activated when the MSD reaches 1; the resolution will be held until the Second Significant Digit (2SD) falls below 8. The circuit thereby allows input frequency changes downward of up to 20% to occur without resolution change.

3-51. Control Logic

3-52. The Control Logic IC, U48, provides most of the logic and timing requirements for the 7261A. U48 works in conjunction with the Function and Resolution ROM's to determine instrument measurement function and range. In the following paragraphs, general Control Logic operations inputs and outputs will be discussed. A brief description of pin designations is presented in Table 3-6.

3-53. Control Logic provides six decade counters. Outputs at pin GC will, by clocking the Main Gate Flip-Flop, enable the Main Gate. Outputs at pin CO will clock the Main Gate. Control Logic will also provide certain gating control signals.

3-54. A general reset (R) is generated by Control Logic whenever a new function is decoded. Inputs at RI (U48-7) from the front panel RESET switch, the reset one-shot (U30-13), power on reset (U30-5) or the remote interface will also cause a general reset. An R signal will reset the eight display decade counters, along with the overflow flip-flop in the Counter Multiplexer U15; the display is set to zero, and a new measurement sequence is initiated. The remote start signal (ST) differs in that the display is not set to zero, while a new measurement sequence is still begun. The decimal point (DP) output is controlled by the decoded RESOLUTION setting and by the strobe inputs from counter-multiplexer U15. The measurement cycle rate (time between successive measurements) is determined by an exterior RC network connected to pin CR. The 7261A will normally start a new measurement cycle automatically. The input on pin SC will allow Control Logic to stop after one measurement. This feature is controlled by a remote START/STOP command or the Channel B input signal if the Rear Panel MODE switch is in the TRIG position.

3-55. When set for autoranging, Control Logic utilizes two feedback paths to the Counter-Multiplexer U15-AO and AR. An internal iteration counter will step through the available resolutions until a Carry 6 is seen on AR or until the lowest resolution step has been reached. Autoranging is not available in TOT A-B or CPM X100A. An internal hysteresis flip-flop is connected to line AO to prevent needless resolution changes during marginal or slightly varying inputs. An internal 14 stage static shift register control sequencing during the measurement cycle.

3-56. Main Gate Clocking Logic

3-57. The Main Gate clock input is determined by the function and resolution range selected. The Control Logic IC and the Function ROMs control the Main Gate Clocking Logic so that the appropriate signal and only the appropriate signal is routed to the Main Gate clock input. There are five general cases:

1. PER A or TI A-B function is selected. When the 10^0 position of the RESOLUTION control is selected, U5 will route 100 MHz from the 10-100 MHz Multiplier PCB to the Main Gate clock input. If the next position of the RESOLUTION control is selected, the EH and CO commands from the Control Logic will command U10 and U28 to route the 10 MHz time base frequency to the Main Gate clock input. Selecting the other positions of the RESOLUTION control will route 1 MHz to 1 kHz (in decade steps) from the CO output of the Control Logic to the Main Gate clock input via U28.

2. If the CHK function is selected, the 10 MHz time base frequency will be routed to the Main Gate clock input via U10 and U28. Position of the RESOLUTION control has no effect on the Main Gate clock input.

3. If either the PER AVG A or TIA A-B function is selected, U5 will route the 100 MHz signal from the 10-100 MHz Multiplier PCB to the Main Gate clock input.

4. If FREQ C function is selected, U23 will route the Channel C ECL signal to the Main Gate clock input.

5. If FREQ A or CPM X100A function is selected, U23 will route the Channel A ECL signal to the Main Gate clock input.

3-58. Main Gate Enable Logic

3-59. As Figure 3-12 shows, the Main Gate is part of the First Decade of the Counter. The Main Gate, U4, is a J-K flip-flop with three input lines that simultaneously control both the J and K inputs. When the J-K inputs are qualified, the frequency present at the clock input of U4 is toggled through the the rest of the First Decade circuit. There are four cases of operation associated with the J-K inputs:

1. If either the TI A-B or TIA A-B function is selected, U32-8 is held low. U4 is controlled by the STOP and START gates of the time Interval Circuit. If any other function is selected, the Function ROMs hold the START and STOP gates so that the two input lines to U4 are permanently qualified. U4 is controlled by U32-8.

2. If FREQ A, CPM X100A or FREQ C (any FREQ C but Direct, i.e., a prescaled Channel C) U32-8 is controlled by the Gate Synchronizer, U21. U21 is controlled by the outputs of the Main Gate F/F (GQ and GQ) and the 100 kHz signal from the Time Base Dividers.

3. If FREQ C (Direct) is selected and the -310 option is installed in the instrument, the FC CDIR input to U31 will cause the U32-8 to enable the Main Gate continuously.

4. If PER A, PER AVG A, TOT A·B, RATIO A/B or CHK function is selected, the GQ signal at U32-9 controls the Main Gate.

3-60. Count Circuits

3-61. The output of the Clock Select circuity is applied to the clock input of the Main Gate, U4. U4, U13 and U21 (along with ECL to TTL converter Q6 and Q7) form the First Decade of the Counter (Digit 1). Digit 2 is counted by the Second Decade, U14. If any function except FREQ C is selected, Digits 1 and 2 are routed through tri-state device U22 to the Digit 1 and Digit 2 inputs of U15. (See the appropriate material in Section 6 for operation when FREQ C is selected.) The remaining six digits (D3-D8) are derived from the Digit 2 carry within Count-Latch-Multiplexer U15. Figure 3-13 provides a simplified schematic diagram of U15. Digit 1 and Digit 2 are applied to separate 4-bit latches within U15. Digit 2 carry is also applied to the Digit 3 BCD counter. Digits 4-8 are derived from similar counters and applied to 4-bit latches. Digit 1-8 information is loaded into the latches upon receipt of the Memory Update (M) signal from Control Logic (U48). Any overflow condition will be applied to the 1 bit overflow latch at the same time.

3-62. A scan counter within U15 controls latched digit outputs and strobes. This counter is driven by an internal oscillator whose frequency is determined by the exterior connection of C13. As the 4-bit contents of each latch (Digit 1-8) is scanned for output, a simultaneous strobe signal (DS1-DS8) is applied to the appropriate display digit. The contents of all seven latches are thus sequentially displayed. Decimal point placement is provided exterior to U15 by Control Logic (U48) and Decimal Point Multiplexer.

3-63. Display

3-64. The output from Counter-Multiplexer, U15, is applied, through BCD-to-Seven Segment Decoder U35, to all display digits. A strobed output from U15 on lines DS1-DS8 enables the appropriate digit through drivers U35 and U36. In overflow conditions, a latched output is applied directly to the OVFL LED.

3-65. Time Interval Logic

3-66. In the Time Interval function, Main Gate enabling is controlled entirely by two D type flip-flops (U7-8 for interval start, U7-6 for interval stop). The Main Gate clocking is provided by the instrument's time base; clocking frequencies from 100 MHz through 1 kHz (respective settings of 10 ns through 1 ms) are selectable with the RESOLUTION control. Function ROM U42-B6 controls the 100 MHz clock via U5 and inhibits all other clock signals via U28. Control Logic pin EH goes high when 100 ns is selected; the 10 MHz reference is thus fed to the Main Gate. In all other RESOLUTION settings for Time Interval mode, EH is low, and Main Gate clocking isprovided from the divided time base at Control Logic pin CO to U4 via U28.

3-67. In the initial state, time interval flip-flop U7-10 is set by Control Logic pin GR and held clear. Control Logic pin TE is also high, providing the D input for the stop flip-flop and enabling the time interval output gate at U2-13. The Channel A start pulse will now clock U7-11 and enable the Main Gate through the AND inputs of U4.

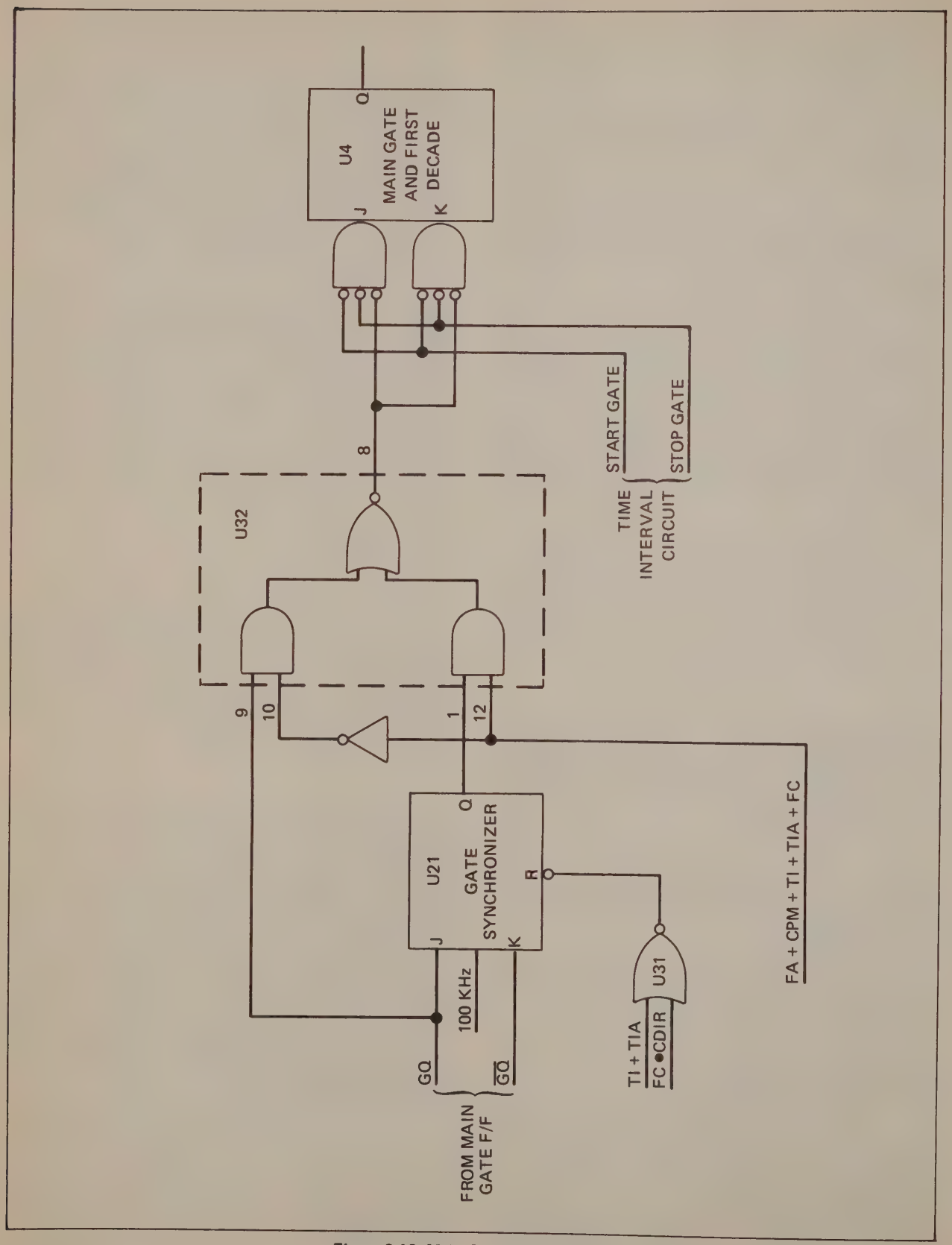


Figure 3-12. Main Gate Enable Logic

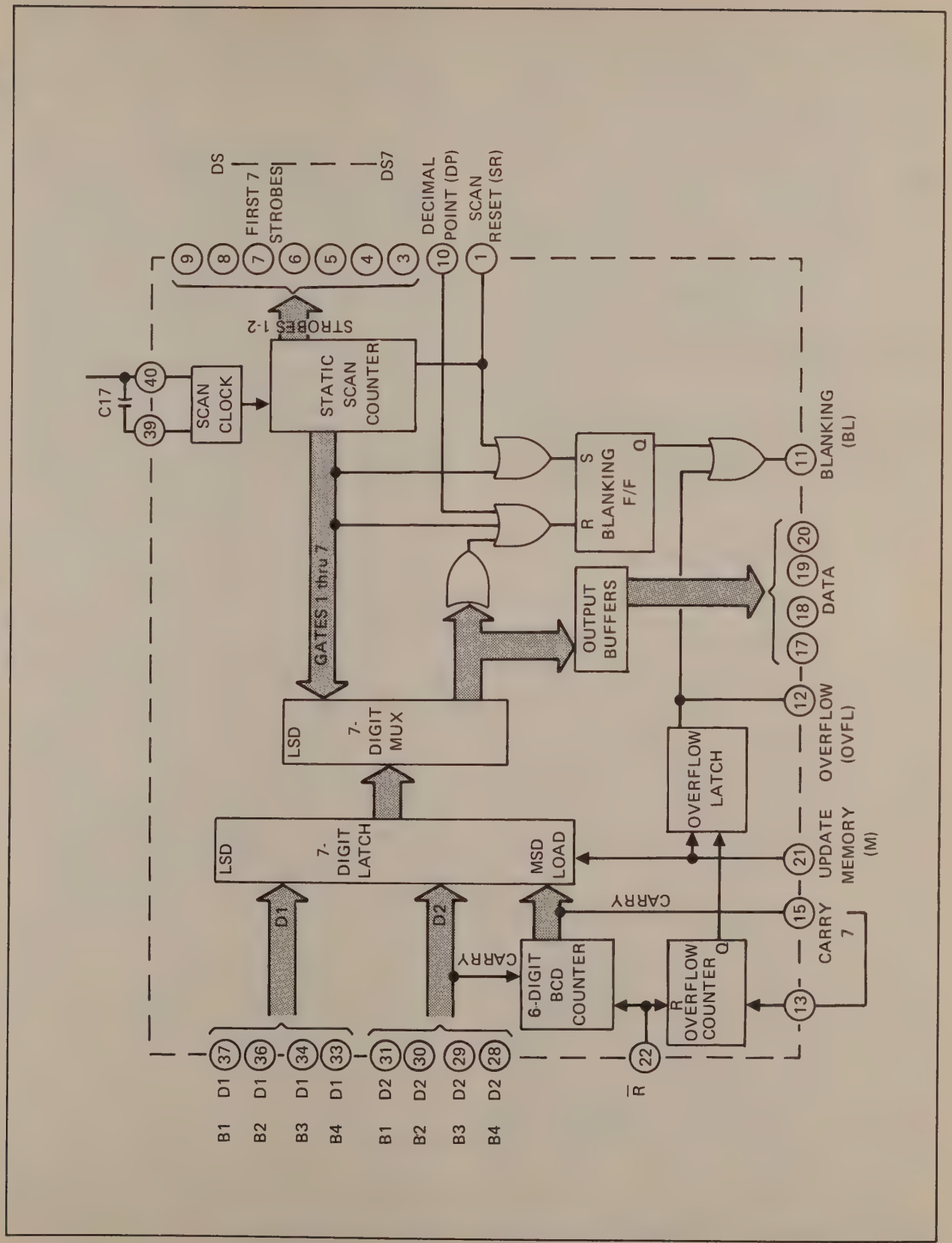


Figure 3-13. Counter, Latches and Multiplexer

This same pulse will clear the stop flip-flop. Any subsequent pulse received on Channel B will then clock the stop flip-flop at U7-3, disabling the Main Gate and outputting a pulse to Control Logic pin TQ. Control Logic will respond by waiting 0.1 ms and providing a memory update command ($\overline{M}$).

3-68. Time Interval Average Logic

3-69. In the Time Interval Average function the Main Gate is controlled by the Time Interval F/F as it was in the Time Interval function. The Control Logic functions essentially the same as it did when in the Period Average function. Gate time is determined by counting the number of time intervals. In the Time Interval Average function, the Control Logic maintains a 4 μsec "dead time" between measurement cycles.

3-70. Just before the beginning of a measurement cycle, the instrument is in 'dead time'. The GQ term is true. As Figure 3-14 shows, this hold both the Start and Stop gates reset and enables the 100 kHz input to the Time Interval Average Control circuit. The 100 kHz signal causes the first 2 usec one-shot to generate a 2 μsec pulse to the input of the Control Logic at a 100 kHz rate. Since the Control Logic is in the PER AVG mode, this input exercises the gate time counter.

3-71. At the beginning of the measurement cycle, GQ goes true. The 100 kHz input to the Time Interval Average Control circuit is inhibited and the gate time counter in the Control Logic is reset. The signal holding the START and STOP gates reset is removed. The first pulse through Channel A will set the Start gate. This qualifies the Main Gate allowing the 100 MHz signal from the 10-100 MHz Multiplier PCB to be counted. If there is no TI Holdoff signal holding the Stop gate reset, the first pulse through Channel B will set the Stop gate. This will disqualify the Main Gate, stopping the count. The Stop gate being set also qualifies the input gate to the Time Interval Control circuit. The first 2 μsec one-shot sends a count pulse to the XA input of the Control logic and sets the F/F. The output of the F/F resets the Start and Stop gates so that the Time Interval F/F circuit is

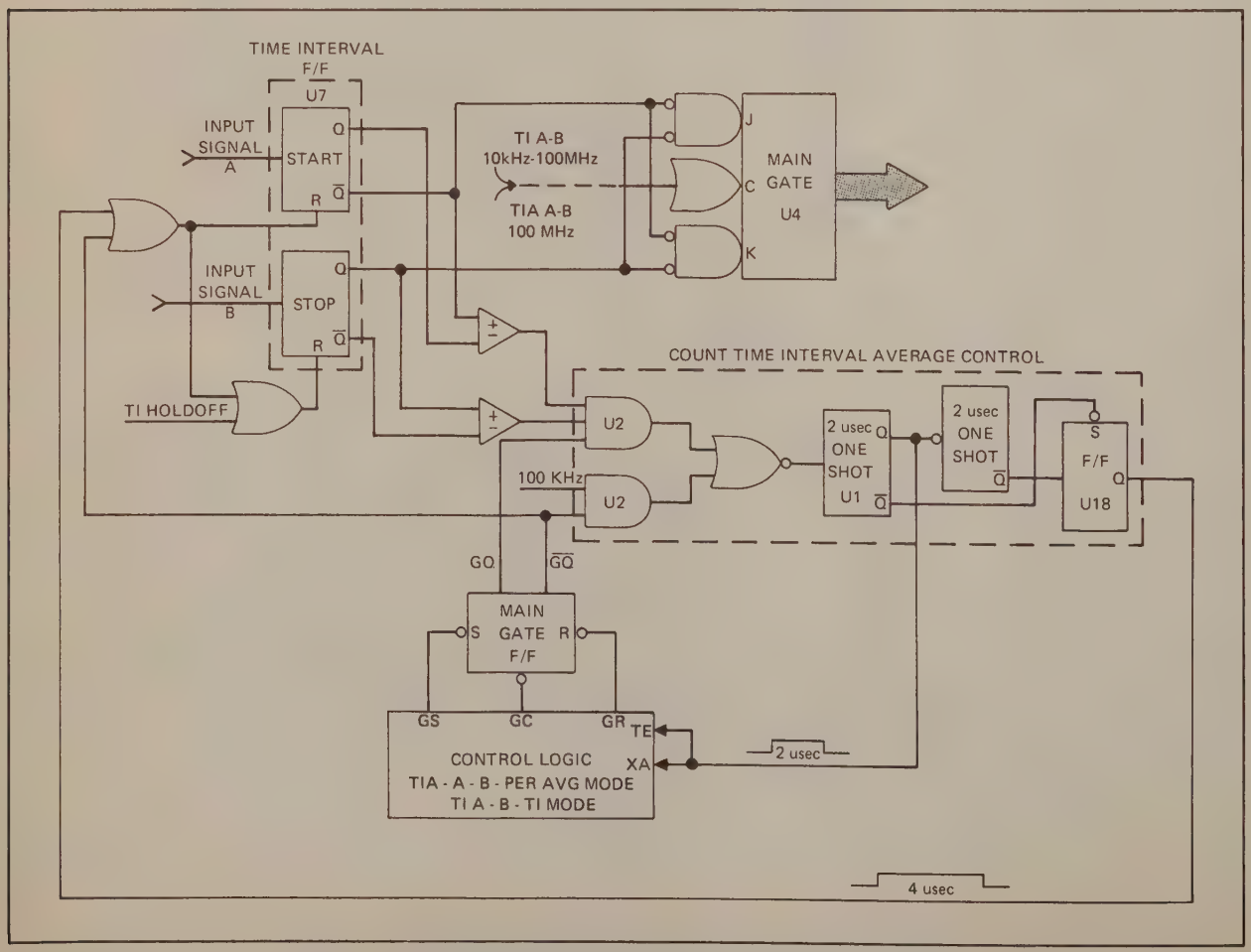


Figure 3-14. Time Interval Average and Time Interval Control Logic

ready to begin another time interval measurement. At the end of each time interval measurement, the Time Interval F/F is reset and the count is increased by one in the gate time counter. This sub-cycle will continue until the count in the gate time counter reaches the number of time intervals selected for averaging by the position of the Front Panel RESOLUTION control. At that time, the Control Logic will disable the Main Gate, ending the measurement cycle. The Counter holds the total count for all the time intervals measured. The position of the RESOLUTION control determines the decimal point position as well as the number of time intervals averaged. This automatically averages the total count. The Control Logic waits through the 200 msec "dead time" and begins another measurement cycle.

3-72. 10-100 MHz Multiplier PCB

3-73. The 10-100 MHz Multiplier is a 100 MHz oscillator phase locked to the 10 MHz precision frequency from the Time Base. Selection of the TIA A-B or PER AVG A functions or the 10 nsec position of the RESOLUTION control during either the TIA A-B or PER A functions will cause the 10 MHz REF and 100 MHz EN signals to be sent to the 10-100 MHz Multiplier PCB. The 100 MHz EN signal acts through Q5 and Q4 to turn on the 100 MHz oscillator Q1 and the 100 MHz buffers, Q2 and Q3. The 100 MHz output of Q3 is divided by ten in U1 and applied to one of the inputs of phase detector U2. The 10 MHz reference from the Main PCB Time Base is the other phase detector input. If there is any phase difference between the two 10 MHz signals, U2 generates a corresponding control voltage to the UP/DOWN charge pump Q6 through Q10. If the -190 Jittered Time Base Option is installed, the phase jitter (modulation input) from the Jittered Time Base PCB will be introduced in the UP/DOWN charge pump. The output of the charge pump is applied to the integrator network R7 and C5 through filter network C6, C7 and L5 to the control voltage input of varactor CR1. This input to CR1 causes a shift in the output of Q1 until the 100 MHz output is phase locked to the 10 MHz reference frequency from the Main PCB. The 100 MHz output of buffer Q2 goes to the Main PCB where it is routed to the clock input of the Main Gate, U4. Since the 100 MHz signal is phase locked to the 10 MHz precision frequency, the accuracy of the 100 MHz is the same as the accuracy of the 10 MHz signal from the Time Base.

3-74. Reset Logic

3-75. Reset from Control Logic ($\overline{R}$) clears the decade counters and initializes the display latches. The reset input (RI) to Control Logic is derived in one of four ways. The front panel RESET switch controls RI for as long as it is held depressed. A power on reset will be provided to RI to allow for stabilization of the 7261A's power supply voltages. Monostable multivibrator U1-12 provides time delay and pulse shaping for this reset. A change in the front panel RESOLUTION setting will also cause a pulsed reset from the power on multivibrator. A remote reset will cause the same reset operations as does the RESET switch. Internally, Control Logic (U48) will generate its own RI whenever a FUNCTION change is decoded. Use of the RESET switch or a remote reset will also place display decoder U46 in lamp test mode; all seven display digits will read "8" for as long as this reset is held applied.

3-76. Marker Output Circuit

3-77. The Marker Output terminal on the Rear Panel of the instrument provides the operator with an electronic indication when Channel A or Channel B Signal Conditioner triggers. The Marker Output circuit consists of two flip-flops, U3 and amplifiers Q9 and Q13. One half of U9 is clocked by Channel A input XA. The ohter half of U9 is clocked by the Channel B input, XB. The two flip-flops toggle each other to alter the output signal present at the Marker Output terminal A positive going waveform indicates that Channel A has trigggered. A negative going waveform indicates that Channel B has triggered.

3-78. Single/Continuous Operation

3-79. The instrument can be programmed to either initiate measurement cycles continuously at a predetermined rate (continuous operation) or initiate one and only one measurement cycle when signaled by the start circuit on the Main PCB (this start circuit is not the same as the START Gate used by the Time Interval circuit). When the instrument is under local control, single or continuous operation is selected by the Rear Panel MODE switch. Remote Operation is described later in this section. When the MODE switch is in the CONT position, the SC (single/continuous) and ST (start) signals from U39 to the Control Logic are both low. This commands the Control Logic to continuously initiate measurement cycles at a predetermined rate. if the MODE switch is in the TRIG position, SC is high commanding the Control Logic to wait for a high level on the ST line before initiating a measurement cycle. With the MODE switch in the TRIG position, ST is determined by the STL input of U39. STL is generated by the start circuit, U10 and U3. If any function except FREQ C is selected, STL is determined by XB. When there is a signal on Channel B, the Control Logic will be commanded to initiate a measurement cycle. If the Channel C function is selected STL will be high if the amplitude of the signal applied to the Channel C input is above the threshold level. As long as the amplitude of the Channel C input signal remains above the threshold level, the Control Logic will operate as if the continuous operation function has been selected. If the amplitude of the Channel C input

signal drops below the threshold level. ST1 will be low causing ST to go low which in turn prevents the Control Logic form initiating another measurement cycle.

3-80. Remote Operation

3-81. If the -521 Option is installed, your instrument can be controlled from a remote location. When the $\overline{\text{REM}}$ signal is true (low), the output of inverter/amplifier U27-4 goes high. This changes the state of tri-state devices U44 and U45 and alters the control coding of multiplexer U39. Changing the state of U44 inhibits local (Front Panel) control of Channels A and B slope (+/- switches) and RESET functions. The remote station now controls the slope and reset functions of the instrument. Changing the state of U45 inhibits local control of the FUNCTION, RESOLUTION and FILT functions of the instrument. The remote station now controls these functions. The altered control coding on U39 changes the source of the ST and SC commands to the Control Logic. If the Rear Panel MODE switch is in the CONT position, ST is controlled by the remote station through the STR input. SC is controlled by the remote station through the SCR input. But, if the MODE switch is in the TRIG position, SC is a continuous high which places the Control Logic in the Single trigger mode. ST is now controlled by the start pulse logic on the Main PCB (local control through the STL term).

3-82. Outputs to the remote station include the data (transmitted serially), strobes, units, decimal point location, indication of when the instrument Main Gate is open, and interface control command exchange. These outputs and their use is described fully in the appropriate part of Section 6.

Section 4
Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual provides information concerning warranty, general maintenance, performance tests, calibration and troubleshooting for the 7261A Universal Counter/Timer. Test equipment recommended for performance tests, calibration, and troubleshooting is listed in Table 4-1. If the recommended equipment is not available, equipment with equivalent specifications may be used.

Table 4-1. Required Test Equipment

EQUIPMENT TYPE	REQUIRED SPECIFICATIONS	RECOMMENDED TYPE
Oscilloscope	Dual trace, DC-200 MHz wide band	Tektronix 475
High Frequency Signal Generator	125 MHz at a level of 1V rms. Time Base 1 X 10^{-8} per day.	John Fluke 6160B with -02 Option
Low Frequency Signal Generator (2)	Up to 10 MHz at a level of 1V rms. Time base 1 X 10^{-8} per day.	John Fluke 6011A
50Ω Termination (3) BNC Tee	Impedance match the UUT.	GR874
Digital Multimeter	AC volts up to 250V ac. DC volts to 1V ±0.01V rms. Resistance - 0 to infinity.	John Fluke 8012A
RF Voltmeter	10 mV rms to 5V rms.	Boonton 92-BD
50Ω Adapter	Impedance match UUT to RF Voltmeter	Boonton 91-8B
Oscilloscope Probe	X10, DC to 125 MHz.	Tektronix P6054A
Variable AC Power Supply	Variable Voltage from 0-250V ac	Variac
Frequency and Time Standard	Aging rate of 5 X 10^{-10}/day or less.	HP5061A
RF Attenuator	0-120 dB in 10 dB steps.	HP255D
3-way splitter	50Ω	HP11667A

4-3. In some parts of the text of this section, referring to the Model 7261A by instrument number or by names such as "instrument" may lead to confusion. Therefore, the instrument may sometimes be referred to as the UUT (Unit Under Test).

4-4. SERVICE INFORMATION

4-5. The instrument is warranted for a period of 1 year upon delivery to the original purchaser. The WARRANTY is located on the back of the title page of this manual.

4-6. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7 of this manual. If requested, an estimate will be provided to the customer before any work is begun on instruments that are beyond the warranty period.

4-7. GENERAL MAINTENANCE

NOTE

To avoid contaminating the pcbs with oil from the fingers, handle the pcbs by their edges or wear gloves. If a pcb does become contaminated, refer to the cleaning procedure.

4-8. Disassembly

4-9. To disassemble the instrument, use the following procedure:

1. Press the power switch to STBY, and remove the line power cord.

2. On the case bottom, remove the six securing screws. Two of these screws will be found in the middle of the case, under the latches. To access either middle screw, as shown in Figure 4-1, alternately push the two latching rails away from the triangular stop. Pull the latch out far enough to reveal the screws.

3. The top half of the case may now be separated from the bottom.

NOTE

Do not hold the case bottom while lifting off the case top. Damage to the Main PCB could otherwise result.

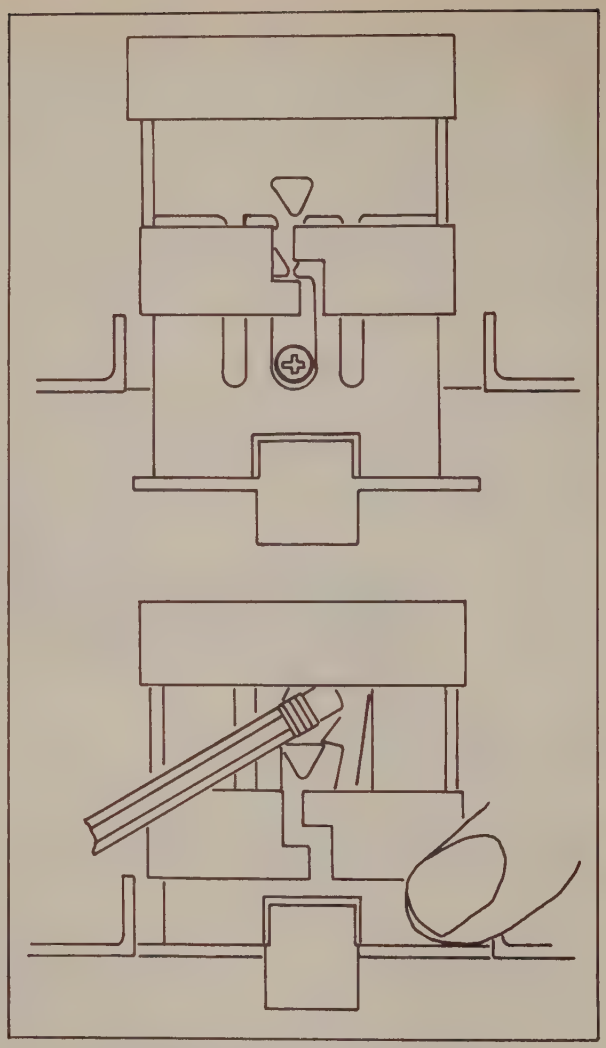


Figure 4-1. Disassembly Screw Access

Alternating between front and back panels, pry the case top free of the rest of the instrument. In the front, press down on the BNC input connectors, while gently pulling up on the case top lip. In the rear, press down on the External Reference BNC connector, while pulling up on the top case lip.

NOTE

For most test and calibration procedures, stop at this step.

4. Remove the single screw at the middle of the Main PCB, and separate the case bottom.

5. Remove the Signal Conditioner Assemblies (A3 and A4) from connectors on the Main PCB and the Front Panel PCB. Pry either assembly gently away from its Front Panel Connector until free. With a gentle rocking motion, now lift the assembly

out of its Main PCB connector. Avoid bending individual connector pins on the Signal Conditioners.

NOTE

The Signal Conditioners must not be interchanged. Each assembly is component matched to a hysteresis resistor on the Main PCB.

6. To remove the Front Panel Assembly (A2) from the Main PCB Assembly, first pull off the following switch buttons in the panel's lower left corner:

a. ON - STBY (green)

b. BAT - LINE (white)

c. RESET (blue)

7. Gently pry the Front Panel Assembly away from its 40-pin connector (left) and guide pin (right). Avoid bending individual connector pins on the Main PCB.

8. Refer to Section 6 of this manual when removing any optional assemblies.

4-10. Reassembly

4-11. For reassembly, the disassembly procedures can generally be followed in reverse. Keep the following considerations in mind:

1. When reinstalling the Signal Conditioners or the Front Panel Assembly, care should be taken not to bend the connector pins.

2. When reconnecting the top and bottom case halves, ensure that the Front and Rear Panels fit into their appropriate grooves in the case top half. Slide the top half into place uniformly. Firmly squeeze top and bottom together (at front and rear), and reinstall the six securing screws.

NOTE

Proper RFI shielding depends on top and bottom case halves being securely mated.

4-12. Input Power

4-13. Input line power voltage is selected by positioning the two switches in the right rear corner of the Main PCB. Each switch (S4 and S5) shows a position identifying red or white dot. Line voltage settings identified by dot color are presented in Figure 4-2. Factory line voltage settings are identified on the instruments's rear panel; one of four (4) white dots will be darkened to signify 100, 120, 220 or 240V selection.

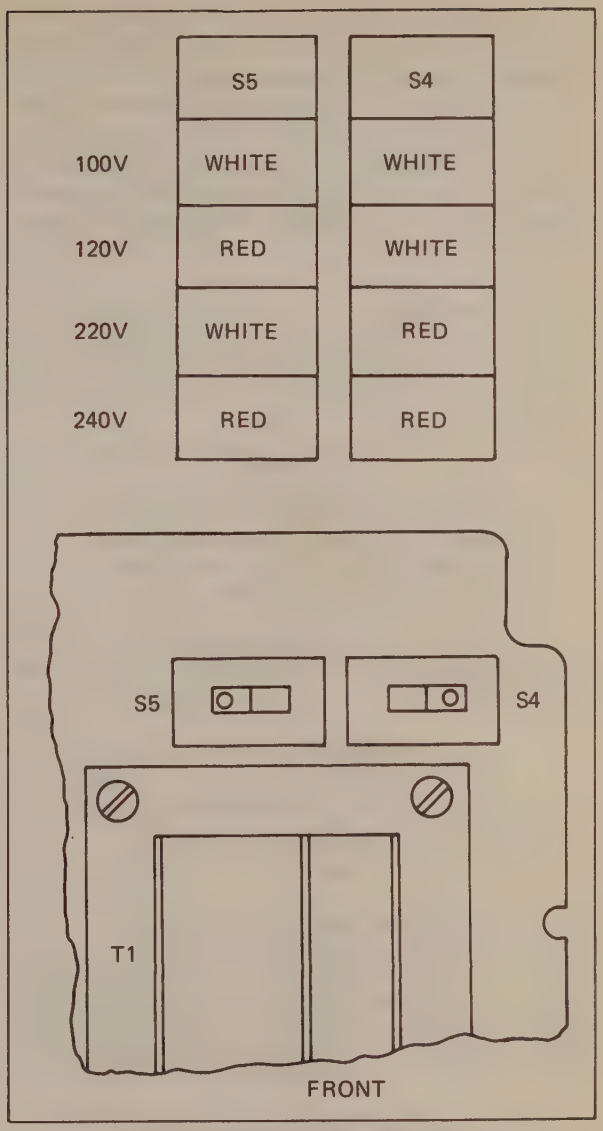


Figure 4-2. Line Voltage Selection

4-14. Fuse Replacement

WARNING

BEFORE ATTEMPTING FUSE REPLACEMENT, REMOVE LINE POWER FROM THE INSTRUMENT.

4-15. The 7261A line power fuse is accessible on the rear panel. Fuse requirements are a 3/8A MDL (slo-blo) for line inputs of 100V or 120V and a 3/16A MDL (slo-blo) for line inputs of 220V or 240V.

CAUTION

For continued five protection alway replace F1 with a 250V fuse of same type and rating.

4-16. Channel A and Channel B inputs are fuse protected for maximum inputs of 250 mA. Replacement of either of these fuses necessitates removal of the Main PCB Assembly and the Front Panel PCB Assembly; refer to Instrument Disassembly for removal instructions. Each fuse is soldered to the Front Panel PCB Assembly immediately below the respective BNC input connector. Replacement fuses should be ordered from John Fluke Mfg. Co., Inc.

4-17. Cleaning

4-18. Clean the instrument periodically to remove dust, grease and other contamination. Use the following procedure:

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They will react with plastic materials used in manufacture of the instrument.

1. Clean the front panel and case with soft cloth dampened with a mild solution of detergent and water.

2. Clean the surface of the PCB using clean, dry air at low pressure (≤20 psi). If grease is encountered, spray with Freon T.F. Degreaser or anhydrous alcohol and remove grime with clean, dry air at low pressure.

4-19. STATIC SENSITIVE DEVICES

4-20. CMOS and PMOS devices may be destroyed by electrostatic discharge resulting from improper handling. Table 4-2 lists the static sensitive devices contained in the 7261A. When working around or handling these devices, use the procedures outlined on the yellow Static Awareness sheet located in this manual.

4-21. SOLDERING PRECAUTIONS

4-22. The Main and Front Panel PCBs are multilayer boards. Irreparable damage may be caused by careless removal or resoldering components. The following board repair procedures are recommended by the John Fluke Mfg. Co., Inc.

1. Restrict soldering iron tip temperatures to 700°.

2. Use a heat regulated soldering iron.

3. Use the compressed air driven vacuum type of desoldering tool.

4. Do not reheat the same pin or pad until it has been allowed to cool. Excessive heat build-up can cause board warpage and separation of inner layers as well as loss of pads and through-hole connections.

5. For IC removal, first cut all pins and gently remove the pins by heating the solder joint. Always work in one direction around the IC to allow previous pins and pads to cool. After the pins are removed, use the vacuum desolderer to remove the solder. Sometines a small filip of solder will remain in the center of the hole and will not melt because not enough heat is carried to it by the copper plating. Resolder the hole, allow to cool, then desolder it. Enough heat must be applied to melt the solder all the way through before suction is applied.

Table 4-2. Static Sensitive Devices

	ASSEMBLY	REF. DES.	TYPE
Standard Instrument	Main PCB Assembly	U15 U34 U46 U48	7031 4078B 14511 Custom
Options			
-521	Printer Interface PCB Assy	U1 U2 U3 U5	MC 14503CP MC 14013CP MC 14011CP 4028AN
-010	Battery PCB Assy	U2	CD4001AE

4-23. PERFORMANCE CHECKS

4-24. The Performance Checks are used to compare the performance of the instrument with the Specifications given in Section 1. The Performance Checks are recommended for incoming inspection, preventative maintenance, evaluation after repair or as an aid in troubleshooting. All of the Performance Checks other than the Time Base Check should be performed quarterly. The Time Base Check should bee performed monthly if operation within the Section 1 Specifications is desired. Should the instrument fail any portion of the Performance Checks, calibration and/or repair is indicated. Refer to Table 4-2 when specific test equipment is called for. Use the RF voltmeter to set up the programmed level of the HF synthesizer.

4-25. Initial Instrument Setup

4-26. Unless otherwise specified, it will be understood that the following controls will be in the indicated position before beginning any Performance Check:

1. On the Rear Panel of the UUT, set the controls to the following position:

ON/OFF	ON
INT/EXT	INT
CONT/TRIG	CONT

Line cord connected to line power.

2. On the Front Panel of the UUT, set the controls to the following position:

ON/STBY	ON
BAT/LINE	LINE
TI HOLDOFF	OFF
RESOLUTION	AUTO
SEP/COM	SEP
FILTER IN/OUT	OUT
TRIGGER LEVEL (A&B)	PRESET
ATTN (A&B)	X1
AC/DC (A&B)	AC
± (A&B)	-

4-27. Display Check

4-28. Use the following procedure to check the function of all segments of the eight display digits, decimal point postioning, all annunciators (except OVEN), and the RESET control.

1. On the Front Panel of the UUT:

   a. Set the ON/STBY switch to the ON position.

   b. In the Channel B signal conditioner section:

      1) Set the Trigger Level control maximum clockwise position.

      2) Set the ± control to the + position.

   c. Set the RESOLUTION control to the 10 kHz position.

   d. Set the FUNCTION control to the CHK position.

2. Verify that:

   a. 10.00 MHz is displayed.

   b. GATE annunciator is flashing approximately five times per second.

3. Depress and hold the RESET pushbutton.

4. Verify that 888888.88 MHz is displayed. If any segment of any digit is not functioning, that digit will not be an 8.

5. Release the RESET pushbutton.

6. Verify that:

   a. 10.00 MHz is displayed.

   b. The GATE annunciator is flashing approximately five times per second.

7. On the Front Panel of the UUT, in the Channel A signal conditioner section and in the Channel B signal conditioner section:

   a. Set the AC/DC switch to the AC position.

   b. Set the ± switch to the + position.

8. Using Table 4-3 as a guide, set the Function to each of the positions indicated. At each of the Function Control positions, sequence the Resolution control to each of its settings. Verify that for each setting of the Function and Resolution control that the digits, decimal point positions and units annunciator all agree with the values given in Table 4-3.

NOTE

When performing this step, the OVFL annunciator illuminates when the Function control is set to the CHK position and the Resolution control is set to the .1 Hz position.

Table 4-3. Display Check

FUNCTION	RESOLUTION SWITCH	DIGIT DISPLAY	UNITS ANNUNCIATOR
FREQ A	10 kHz	0.00	MHz
	1 kHz	0.000	MHz
FREQ C	100 kHz	.0000	MHz
	10 Hz	0.00	kHz
	1 Hz	0.000	kHz
	.1 Hz	0.0000	kHz
	AUTO	0.000	kHz
CPM X100A	All settings	0	Blank
RATIO A/B	10^0	0	Blank
	10^1	0.0	Blank
	10^2	0.00	Blank
	10^3	0.000	Blank
	10^4	0.0000	Blank
	10^5	0.00000	Blank
	AUTO	0	Blank
PER A	10 ns	0.00	μsec
	100 ns	0.0000	msec
	1 μs	0.000	msec
TI A-B	10 μs	0.00	msec
	100 μs	0.0000	sec
	1 ms	0.000	sec
	AUTO	0.00	msec
PER AVG A	10^0	.00000	msec
	10^1	.000000	msec
TIA A-B	10^2	.0000	μsec
	10^3	.00000	μsec
	10^4	.000000	μsec
	10^5	.0000000	μsec
	AUTO	.00000	msec
TOT A·B	All settings	0	Blank
CHK	10 kHz	10.00	MHz
	1 kHz	10.000	MHz
	100 Hz	10.0000	MHz
	10 Hz	10000.00	kHz
	1 Hz	10000.000	kHz
	.1 Hz	*0000.0000	kHz
	AUTO	10000.000	kHz

*OVFL annunciator turns on after 10 sec gate time

4-29. Sensitivity Check, Channel A

4-30. Use the following procedure to verify that Channel A meets the sensitivity specifications listed in Table 1-2.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	FREQ A
RESOLUTION -	10 Hz
SEP/COM -	SEP
AC/DC, Channel A -	DC

2. On the Rear Panel of the UUT, set the REF switch to EXT.

3. Connect the equipment in the configuration shown in Figure 4-3, Part A.

4. Program the LF synthesizer for an output of 10 kHz at a level of 100 mV rms.

5. Verify the UUT display is 10.00 kHz ±1 count.

6. Reduce the programmed output level of the LF synthesizer until the error is greater than ±1 count. The programmed level should be less than 10 mV rms.

7. On the Front Panel of the UUT, set the Channel A ATTEN control to the X10 position.

8. Program the LF synthesizer for an output level 23 dB above the sensitivity level measured in step 6 above.

9. Verify that the UUT display is 10.00 kHz ±1 count.

10. Program the LF synthesizer for an output level 17 dB above the sensitivity level measured in step 6 above.

11. Verify that the UUT display is either all zeros or no longer ±1 count.

12. On the Front Panel of the UUT, set the Channel A ATTEN control to the X100 position.

13. Program the LF synthesizer for an output level 43 dB above the sensitivity level measured in step 6 above.

14. Verify that the UUT display is 10.00 kHz ±1 count.

15. Program the LF synthesizer for an output level 37 dB above the sensitivity level measured in step 6 above.

16. Verify that the UUT display is either all zeros or no longer ±1 count.

17. On the Front Panel of the UUT, set the Resolution control to the 1 Hz position.

18. Connect the equipment in the configuration shown in Figure 4-3, Part B.

19. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 50 MHz at a level of 100 mV.

20. Verify that the UUT display is 500000.000 kHz ±1 count.

21. Reduce the level input to the UUT until display is no longer ±1 count.

22. Verify that the voltmeter reading is less than 10 mV.

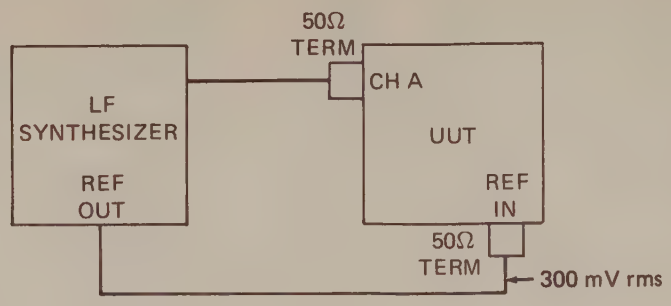
23. On the Front Panel of the UUT, set the Resolution control to the 10 Hz position.

24. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 125 MHz at a level of 100 mV.

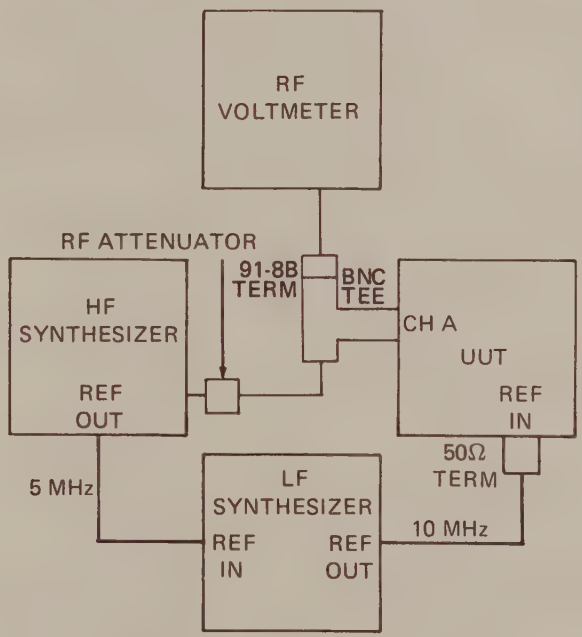
25. Verify that the UUT display is 125000.00 kHz ±1 count ±time base error.

26. Reduce the level of the UUT input until the error is greater than ±1 count.

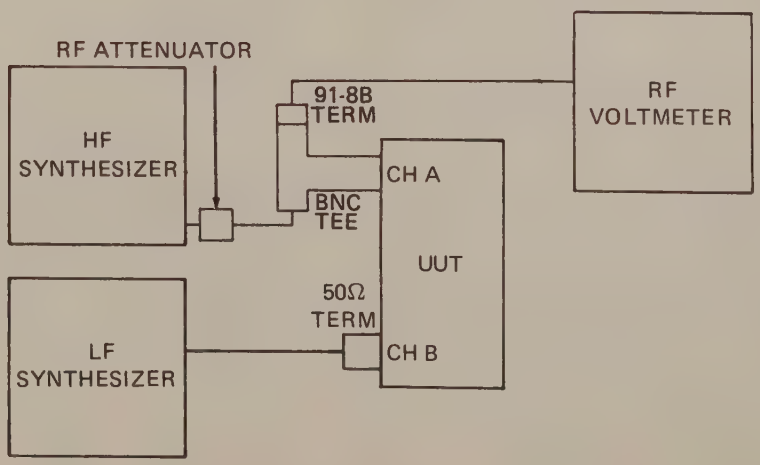
27. Verify that the voltmeter reading is less than 35 mV.



A.



B.



C.

Figure 4-3. FREQ A Check

4-31. Sensitivity Check, Channel B

4-32. Use the following procedure to verify that Channel B meets the sensitivity specifications listed in Table 1-2.

1. On the Front Panel of the UUT, set the controls as follows:

FUNCTION -	RATIO A/B
RESOLUTION -	10^8

2. Connect the equipment in the configuration shown in Figure 4-3, Part C.

3. Adjust the RF attenuator and program the HF synthesizer for an input to the UUT of 100 MHz at a level of 50 mV rms.

4. Program the LF synthesizer for an output of 100 kHz at a level of 50 mV rms.

5. Verify that the UUT display is 1000 ±1 count.

6. Reduce the LF synthesizer programmed level until the UUT display has slightly more than ±1 count error.

7. Verify that the LF synthesizer programmed level is less than 10 mV rms.

8. On the Front Panel of the UUT, set the Channel B ATTEN control to the X10 position.

9. Program the LF synthesizer for an output level 23 dB above the sensitivity level measured in step 6.

10. Verify that the UUT display is 1000 ±1 count.

11. Program the LF synthesizer for an output level 17 dB above the sensitivity level measured in step 6.

12. Verify that the UUT display is either all zeros or greater than ±1 count error.

13. On the Front Panel of the UUT, set the Channel B ATTEN control to the X100 position.

14. Program the LF synthesizer for an output level 43 dB above the sensitivity level measured in step 6.

15. Verify that the UUT display is 1000 ±1 count.

16. Program the LF synthesizer for an output level 37 dB above the sensitivity level measured in step 6.

17. Verify that the UUT display is either all zeros or greater than ±1 count.

18. On the Front Panel of the UUT, set the Channel B ATTEN control to the X1 position.

19. Program the LF synthesizer for an output of 2 MHz at a level of 50 mV rms.

20. Verify that the UUT display is 50 ±1 count.

21. Program the LF synthesizer for an output of 2 MHz at a level of 10 mV rms.

22. Verify that the UUT display is 50 ±1 count.

4-33. Time Base Check

4-34. Use the following procedure to check the accuracy of the time base and the operation of the REF OUT circuitry.

1. On the UUT, set the Front Panel controls as follows:

FUNCTION -	FREQ A
RESOLUTION -	.1 Hz
ON/STBY -	ON

2. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50Ω termination and the shortest length of RG-58 possible.

3. Program the LF synthesizer for an output of 5 MHz at a level of 1V, OPEN.

4. Verify on the UUT that the display reading is 5 MHz ± maximum allowable count error of ±28.1 Hz. The maximum allowable count error can be computed for any input signal by multiplying the frequency of the input signal by the total time base accuracy ($\pm 56 \times 10^{-7}$) and then adding the ±1 count to the product.

5. Connect the oscilloscope to the REF OUT terminal on the UUT through as short a length of RG-58 as possible. The oscilloscope end of the test cable must have a 50Ω termination.

6. Verify that the waveform displayed on the oscilloscope is a 10 MHz square wave with the logic high greater than .5V.

4-35. Frequency A Function Check

4-36. Use the following procedure to check the FREQ A function of the instrument.

1. On the Front Panel of the UUT, set the controls to the following position:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	10 kHz
AC/DC, CHANNEL A -	AC
SEP/COM -	SEP
ATTN CHANN A -	X 1
SLOPE, CHANN A -	—

2. On the Rear Panel of the UUT, set the REF switch to the EXT position.

3. Connect the HF synthesizer to the Channel A input terminal via a 50Ω termination as shown in Figure 4-3, Part B.

4. Program the HF synthesizer for the UUT inputs shown in Table 4-4 for each position of the ATTENUATION switch on the UUT.

5. Verify that the UUT display agrees with the frequency programmed ±1 count.

6. On the Front Panel of the UUT, set the Channel A ± switch to +.

7. Repeat steps 3 and 4.

8. Disconnect the HF synthesizer and connect the LF synthesizer as shown in Figure 4-3, Part A.

9. On the Front Panel of the UUT, set the Resolution control to the positions indicated in Table 4-5. For each setting of the Resolution control, program the LF synthesizer for the indicated output frequency and level.

10. Verify that the UUT display is within ±1 count of the frequency programmed in each step of Table 4-5.

11. On the Front Panel of the UUT, set the ± switch in the – position.

12. Repeat steps 8 and 9.

Table 4-4. FREQ A Function Check - High Frequencies

HF SYNTHESIZER PROGRAMMED VALUES	
LEVEL (rms)	FREQUENCY (MHz)
10 mV	1 10 25 50
15 mV	60 70 80 90 100
35 mV	110 125

Table 4-5. FREQ A Function Check - Low Frequencies

	LF SYNTHESIZER PROGRAMMED FREQUENCY	
RESOLUTION CONTROL	FREQUENCY	LEVEL (rms)
		X1
1 Hz	10 Hz 100 Hz 1 kHz	10 mV
100 Hz	1 kHz 10 kHz 100 kHz 1 MHz	10 mV

4-37. CPM X100A Function Check

4-38. Use the following procedure to check the CPM X100A function of the instrument.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	CPM X100A
RESOLUTION -	0.1 Hz
FILTER -	IN
ON/STBY -	ON

2. Connect the LF synthesizer to the Channel A input of the UUT via a 50Ω termination.

3. Program the LF synthesizer for an output of 5 kHz at a level of 100 mV rms.

4. Verify on the UUT that:

   a. 3000 is displayed.

   b. Decimal point is blank.

   c. No units annunciator is illuminated.

5. On the Front Panel of the UUT, sequence the Resolution control to all of its positions.

6. Verify on the UUT that:

   a. The display remains unchanged.

   b. No decimal point is illuminated.

   c. No units annunciator is illuminated.

4-39. Ratio A/B Function Check

4-40. Use the following procedure to check the Ratio A/B function of the UUT.

1. On the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	RATIO
RESOLUTION -	10 kHz
+/–, Channels A & B -	+
AC/DC, Channels A & B -	DC

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE control to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-4.

4. Program the LF synthesizer for an output of 2.0 MHz at a level of 100 mV rms.

5. Program the HF synthesizer so that the UUT input is the frequencies listed in Table 4-6 at a level of 100 mV rms.

6. Verify that the UUT display agrees within ±1 count with the value listed in Table 4-6 for each frequency programmed into the HF synthesizer.

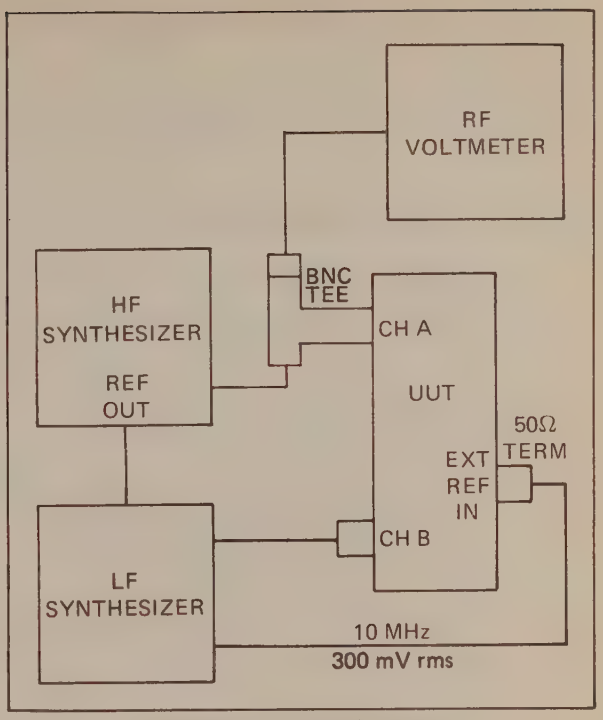


Figure 4-4. Ratio A/B Check

Table 4-6. RATIO A/B Function Check

HF SYNTHESIZER PROGRAMMED FREQUENCY (MHz)	UUT DISPLAY
10	5.00000
20	10.00000
50	25.00000
60	30.00000
70	35.00000
80	40.00000
90	45.00000
100	50.00000
110	55.00000
120	60.00000
130	65.00000
140	70.00000

4-41. Period A Function Check

4-42. Use the following procedure to check the Period A function of the UUT:

1. On the Front Panel of the UUT, set the Function control to the PER A position.

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the equipment as shown if Figure 4-3, Part A.

4. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-7.

5. For each position of the Resolution control:

a. Program the LF synthesizer for an output.

1) Level of 100 mV rms.

2) Frequency indicated in Table 4-7.

b. Verify on the UUT that:

1) The display agrees with the appropriate Display value listed in Table 4-7 ± the appropriate error listed in the table.

2) The unit's annunciator agrees with the units following the display value.

Table 4-7. PER A Function Check

LF SYNTHESIZER	UUT		
FREQUENCY PROGRAMMED	RESOLUTION SWITCH	DISPLAY	ERROR(± COUNTS)
2 MHz	10 nsec	0.50 μsec	±1
100 kHz	10 nsec	10.00 μsec	±3
10 kHz	100 nsec	0.1000 μsec	±3
1 kHz	1 μsec	1.000 msec	±3
100 Hz	10 μsec	10.00 msec	±3
10 Hz	100 μsec	0.1000 sec	±3
1 Hz	1 msec	1.000 sec	±3

4-43. PER AVG A Function Check

4-44. Use the following procedure to check the Period Averaging function of the UUT.

1. On the Front Panel of the UUT, set the Function control to the PER AVG A position.

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE control to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-3, Part A.

4. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-8.

5. Program the LF synthesizer for an output frequency of 100 kHz at a level of 100 mV rms.

6. On the Front Panel of the UUT, set the Resolution control to the positions listed in Table 4-8.

7. Verify on the UUT that for each position of the Resolution switch:

a. The display agrees with the value listed in Table 4-8.

b. The unit's annunciation agrees with the unit listed for that display reading in Table 4-8.

Table 4-8. PER AVG A Function Check

RESOLUTION	DISPLAY	ERROR (± COUNTS)
AUTO	10.00000 μsec	±1
10^5	0.0000000 μsec*	±1
10^4	10.000000 μsec	±1
10^3	10.00000 μsec	±1
10^2	10.0000 μsec	±1
10^1	0.010000 msec	±1
10^0	0.01000 msec	±3
*OVFL annunciator is illuminated		

4-45. TI A-B Function Check

4-46. Use the following procedure to check the Time Interval A to B function of the UUT.

1. On the Front Panel of the UUT, set the controls as follows:

FUNCTION -	TI A-B
SEP/COM -	COM
AC-DC -	DC
±, CHANNEL A -	+
±, CHANNEL B -	-

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-3, Part A.

4. On the Front Panel of the UUT, set the Resolution control to each of the positions listed in Table 4-9.

5. For each position of the Resolution control:

a. Program the LF synthesizer for an output:

1) Level of 2V rms.

2) Frequency indicated in Table 4-9 for that position of the Resolution control.

b. Verify on the UUT that:

1) The displayed value agrees within ±1 count of the value listed under Display for the position of the Resolution control selected and the LF synthesizer frequency programmed.

2) The unit's annunciator agrees with the units for that Display value.

6. On the Front Panel of the UUT, set the controls to the following positions:

RESOLUTION -	10^1
HOLDOFF -	Maximum counter clockwise but not in OFF position

7. Program the LF synthesizer for an output of 2 MHz at a level of 2V rms.

8. Verify that the display is not greater than 0.01YY msec. (Y = don't care.)

9. On the Front Panel of the UUT, rotate the TI Holdoff control maximum clockwise.

10. Verify on the UUT, that the display reading is not less than 20.YYYY msec. (Y = don't care.)

Table 4-9. TI A-B Function Check

LF SYNTHESIZER	UUT	
	RESOLUTION CONTROL	DISPLAY
100 kHz	10 nsec	5.00 µsec
10 kHz	100 nsec	.0500 msec
1 kHz	1 µsec	0.500 msec
100 Hz	10 µsec	5.00 msec
10 Hz	100 µsec	.0500 sec
10 kHz	AUTO	.0500 msec

4-47. TIA A-B Function Check

4-48. Use the following procedure to check the Time Interval, A to B averaging function of the UUT.

1. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	TIA A-B
SEP/COM -	SEP
AC-DC -	AC
±, CHANNEL A -	+
±, CHANNEL B -	-

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the equipment in the configuration shown in Figure 4-5.

4. Program the LF synthesizer for an output frequency at 1.12345 MHz at a level of 2V rms.

5. On the Front Panel of the UUT, set the Resolution control to the positions indicated in Table 4-10.

6. Verify that the UUT display agrees with Table 4-10.

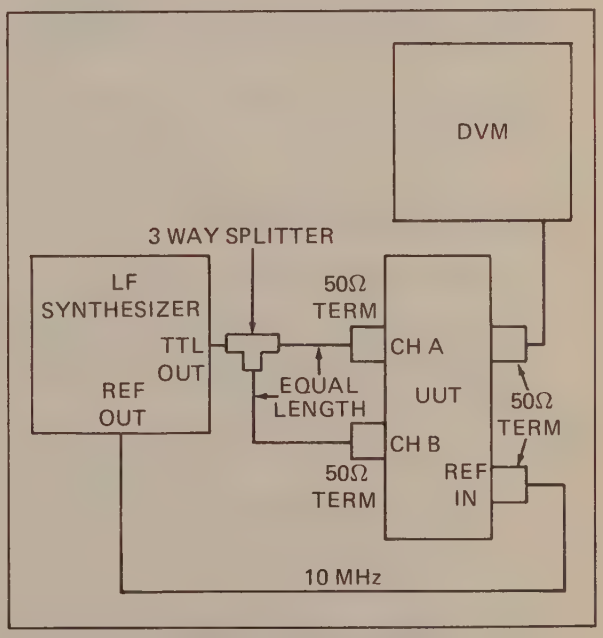


Figure 4-5. TIA A-B Check

Table 4-10. TIA A-B Function Check

RESOLUTION CONTROL	DISPLAY	JITTER (in COUNTS)	ERROR
10^0	.00044 msec	±1	$\pm\frac{\pm 2\text{ ns} \pm \text{Time Base Error} (10\text{ ns} + \text{Trig. Error})}{N}$
10^1	.000445 msec	±3	
10^2	.445 µsec	±10	
10^3	.4450 µsec	±33	
10^4	.44505 µsec	±100	
10^5	.445055 µsec	±330	

4-49. Continuous/Single Trigger Check

4-50. Use the following procedure to verify that the UUT performs properly when either continuous or single triggering is selected.

1. On the Front Panel of the UUT, set the controls to the following positions:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	1 Hz
±, CHANNEL A -	+
±, CHANNEL B -	+
TRIGGER LEVEL, CHANNEL B -	Fully Clockwise
CHANNEL A	PRESET

2. On the Rear Panel of the UUT, set the MODE switch to the TRIG position.

3. Connect the LF synthesizer to the Channel A input on the Front Panel of the UUT with as short a length of RG-58 as possible via a 50Ω termination.

4. Program the LF synthesizer for an output of 10 MHz at 100 mV rms.

5. On the Front Panel of the UUT, press and release the RESET pushbutton.

6. Verify that the display is 0.000 kHz.

7. On the Front Panel of the UUT, rotate the Channel B Trigger Level control fully counterclockwise.

8. Verify that:

   a. The GATE annunciator flashes once.

   b. 10000.000 kHz is displayed.

9. On the Rear Panel of the UUT, set the CONT/TRIG switch to the CONT position.

10. Verify that:

   a. The GATE annunciator is flashing.

   b. 100000.000 kHz is displayed.

4-51. External Reference Input Check

4-52. Use the following procedure to check proper performance of the instrument with an external reference input used as time base.

NOTE

Both synthesizers used must be synchronous to a common reference.

1. On the Front Panel of the UUT, set the controls to the following positions:

ON/STBY -	ON
FUNCTION -	FREQ A
RESOLUTION -	10 Hz
AC/DC, Channels A & B -	DC
±, Channels A & B -	+

2. On the Rear Panel of the UUT, set the INT/EXT REFERENCE switch to the EXT position.

3. Connect the LF synthesizer to the EXT REF terminal on the Rear Panel of the UUT via a 50Ω termination.

4. Program the LF synthesizer for an output of 10 MHz at a level of 300 mV rms.

5. Connect the HF synthesizer to the Channel A input terminal of the Front Panel of the UUT.

6. Program the HF synthesizer for an input to the UUT of 100 MHz at a level of 100 mV rms.

7. Verify that the display of the UUT is 100000.00 kHz ±1 count.

8. Increase the programmed frequency of the HF synthesizer by 100 Hz.

9. Verify that the display of the UUT is 100000.10 kHz ±1 count.

10. Increase the programmed frequency of the HF synthesizer by 100 Hz.

11. Verify that the display of the UUT is 10000.20 kHz ±1 count.

4-53. Marker Check

4-54. Use the following procedure to check the MARKER output.

1. On the Front Panel of the UUT, set the controls in the following positions:

ON/STBY -	ON
FUNCTION -	RATIO A/B
RESOLUTION -	100
SEP/COM -	COM
AC/DC, Channels A & B -	DC

2. Connect the LF synthesizer and dual trace oscilloscope to the UUT as shown in Figure 4-6.

3. Program the LF synthesizer for an output of 1 kHz at a level of 1V rms.

4. On the Front Panel of the UUT, set the ± controls to: Channel A, +; Channel B, –.

5. Verify that the waveform displayed on the oscilloscope is about the same as the waveform shown in Figure 4-7, Part A.

6. On the Front Panel of the UUT, set the ± controls to: Channel A, –; Channel B, +.

7. Verify that the waveform displayed on the oscilloscope is about the same as the waveform shown in Figure 4-7, Part B.

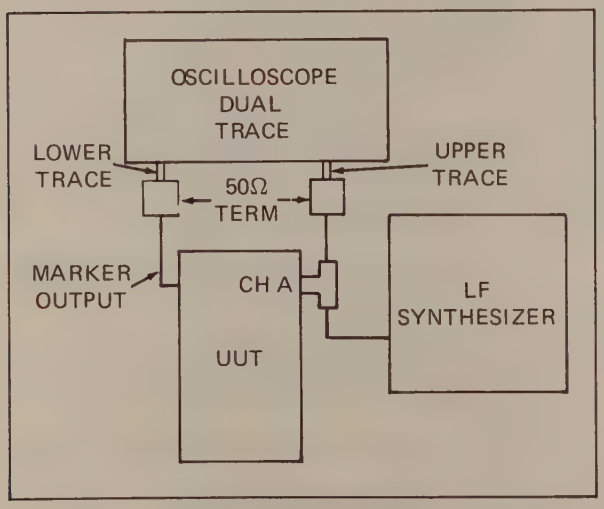


Figure 4-6. Marker Check

4-55. Filter Check

4-56. Use the following procedure to check the opeation of the 100 kHz low pass filter on Channel A and Channel B of the UUT.

1. Set the Front Panel of the UUT, set the controls to the following position:

FUNCTION -	FREQ A
RESOLUTION -	1 kHz
FILTER -	OUT
ON/STBY -	ON
±, Channels A & B -	+
AC/DC, Channels A & B -	DC

2. On the Rear Panel of the UUT, set the REF switch to EXT.

3. Connect the equipment as shown in Figure 4-3A.

4. Program the LF synthesizer connected to Channel A for an output of 1.0 MHz at a level of 10 mV.

5. Verify on the UUT that, 1.000 MHz is displayed.

6. On the Front Panel of the UUT, set the Channel A FILTER switch to the IN position.

7. Verify on the UUT that, 0.000 MHz is displayed.

4-57. CALIBRATION ADJUSTMENTS

4-58. These procedures should be performed whenever the instrument has been repaired or fails to pass the Performance Checks.

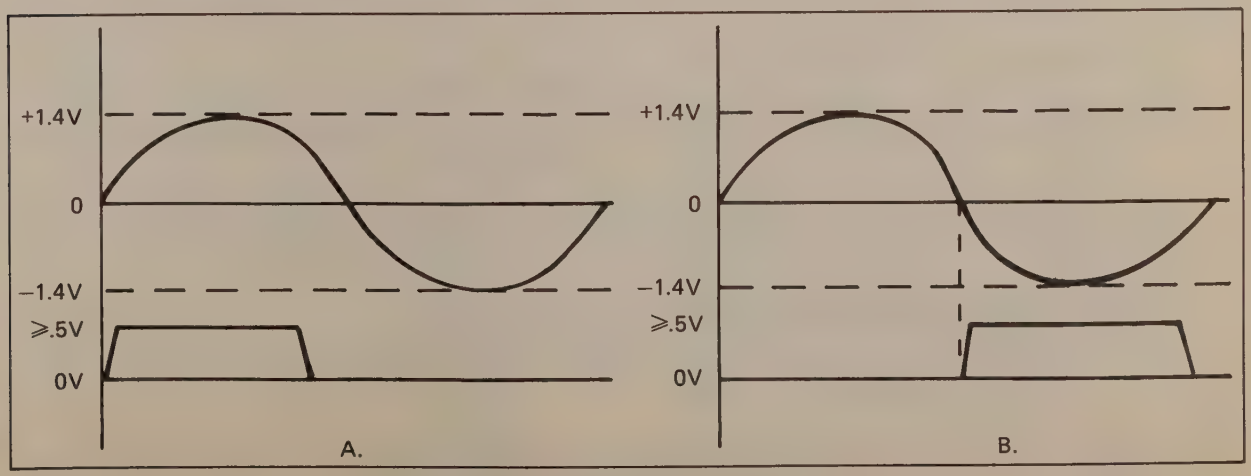


Figure 4-7. Marker Output Waveform

4-59. Power Supply Voltage Adjustments

4-60. Use the following procedure to adjust the power supply voltages in the UUT. Figure 4-8 shows the location of test point and adjustments.

1. Remove the top instrument case cover. (Use the disassembly procedure presented earlier in this section.)

2. Connect the instrument to line power through a Variac set to zero volts.

3. On the Front Panel of the UUT, in the POWER section, set the ON/STBY switch to the STBY position.

4. On the Rear Panel of the UUT, set the AC POWER switch to the ON position.

5. Using the line voltage selection guide presented earlier in this section, set S4 and S5 to the proper position to select local line voltage. If the instrument is to be used for areas with more than one line voltage, set S4 and S5 for the line voltage used most. (This voltage will be considered local line voltage for the remainder of this procedure.)

6. Set the Variac for an output voltage of 120V ac.

7. Connect the DVM to the UUT, + to TP1, – to E1 (or any other UUT common point). See Figure 4-8 for aid in locating test points or adjustments.

8. Adjust R4 for a DVM display of +5.00 ±0.05V.

9. Move the +DVM connection from TP1 to TP2.

10. Verify that the DVM display is +12 ±0.6V.

11. Move the DVM + connection from TP2 to TP4.

12. Verify that the DVM display is –12 ±0.6V.

13. On the Front Panel of the UUT, in the POWER section, set the ON/STBY switch to the ON position.

14. Move the +DVM connection from TP4 to TP3.

15. Verify that the DVM display is –5.0 ±0.15V.

16. Select the ac-coupled mode on the oscilloscope.

17. Connect the oscilloscope probe to TP1, then, in turn, TP2, TP3, and TP4.

18. Verify that at each test point the ripple voltage is less than 50 mV p-p.

19. Set the Variac output to local line voltage plus 10% of local line voltage.

20. Use the DVM to verify that the voltage present at TP1, TP2, TP3, and TP4 is within the range listed in steps 8, 10, 12 and 15.

21. Repeat steps 16 through 18.

22. Set the Variac output to local line voltage minus 10% of local line voltage.

23. Repeat step 20.

24. Repeat steps 16 through 18.

25. If the instrument is to be operated with other line power voltages:

a. On the Rear Panel of the UUT, set the AC POWER switch to the OFF position.

b. Set the Variac to zero volts.

c. Set S4 and S5 to the proper position for the line voltage desired.

d. On the Rear Panel of the UUT, set the AC POWER switch to the ON position.

e. Set the Variac to the desired line voltage.

f. Perform steps 16 through 18.

g. Repeat sub-steps a through f for each line voltage that the instrument will be powered on.

4-61. Channel A Trigger Level Adjustment

4-62. Use the following procedure to adjust the Channel A Trigger Level:

1. On the Front panel of the UUT, set the controls to the following position.

FUNCTION -	FREQ A
RESOLUTION -	10 kHz
ATTEN (CH A) -	X1
AC/DC (CH A) -	DC
±, (CH A) -	+
TRIGGER LEVEL (CH A) -	PRESET
SEP/COM -	SEP

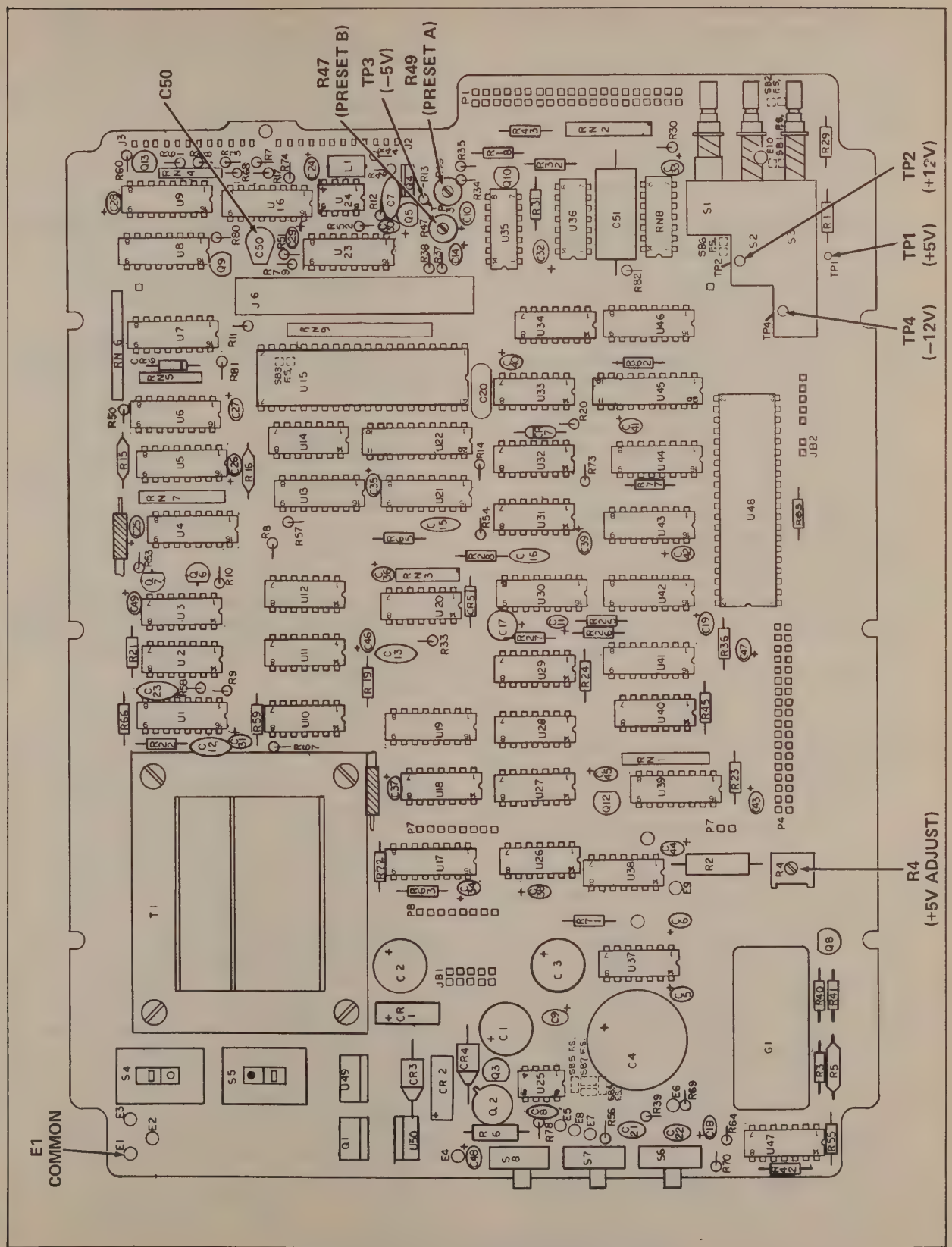


Figure 4-8. Location of Test Points and Adjustments

2. On the Rear Panel of the UUT, set the controls to the following positions:

REF -	EXT
TRIGGER LEVEL -	CH A
AC POWER -	ON

3. Connect the equipment as shown in Figure 4-9A.

4. Program the LF synthesizer for an output of 1 MHz at a level of 10 mV rms.

5. Is the UUT display stable 1.00 MHz?

YES -	Go to step 6
NO -	Increase the level programed into the LF synthesizer until the UUT display is a stable 1.00 MHz. Then continue to step 6.

6. Adjust R49, the PRESET A adjustment, on the Main PCB until the Channel A + and – trigger indicators glow with equal intensity.

7. Reduce the programmed level until the display becomes unstable.

8. Repeat steps 5 and 6.

9. Repeat steps 7 and 8 until maximum sensitivity or a programmed level of 8 mV rms is reached. maximum sensitivity must be less than 10 mV rms.

10. On the Front Panel of the UUT, set the Channel A ± switch to the – position.

11. Verify that on the UUT:

a. The + and – trigger indicators glow with equal intensity.

b. The display is a stable 1.00 MHz.

12. On the Front Panel of the UUT, rotate the Channel A Trigger Level control maximum clockwise.

13. Verify that:

a. The – trigger indicator is on and the + trigger indicator is off.

b. The DVM display is ≤ –1.5V.

14. On the Front Panel of the UUT, rotate the Channel A Trigger Level control counterclockwise as far as it will go without switching into the PRESET position.

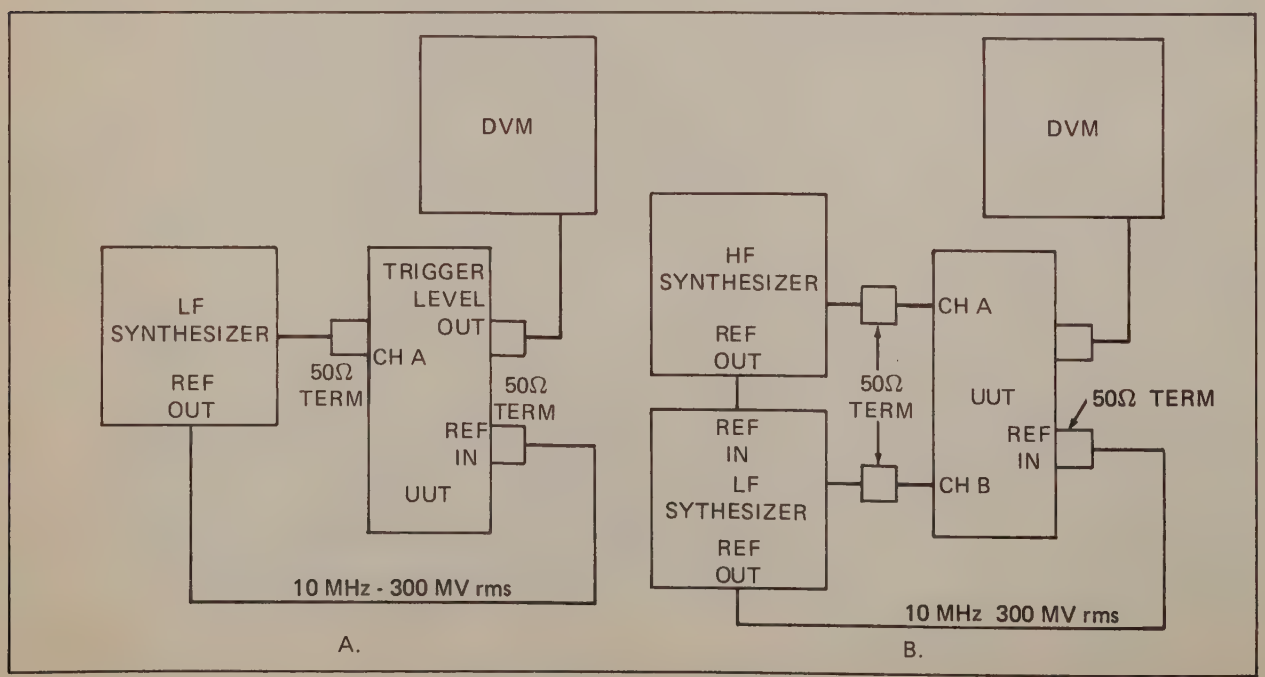


Figure 4-9. Trigger Level Adjustment

15. Verify that:

a. The + trigger indicator is on and the – trigger indicator is off.

b. The DVM display is ≥ +1.5V rms.

4-63. Channel B Trigger Level Adjustment

4-64. Use the following procedure to adjust the Channel B Trigger Level:

1. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	RATIO A/B
RESOLUTION -	10^3
AC/DC (CH A&B) -	DC
± (CH A&B) -	+
SEP/COM -	SEP
TRIGGER LEVEL -	PRESET

2. On the Rear Panel of the UUT, set the controls to the following position:

REF -	EXT
TRIGGER LEVEL -	CH B
AC POWER -	ON

3. Connect the equipment as shown in Figure 4-9B.

4. Program the LF synthesizer for an output of 1 MHz at a level of 10 mV rms.

5. Program the HF synthesizer for an output of 1.0 MHz at a level of approximately 300 mV rms.

6. On the UUT, is the GATE annunciator flashing and display stable 1.000 ±1?

YES	Proceed to step 6.
NO	Increase the programmed level of the LF synthesizer until the GATE annunciator flashes and the display is a stable 1.000 ±1. Then proceed to step 6.

7. Adjust R47, the PRESET B adjustment, on the Main PCB until the Channel B + and – trigger indicators glow with equal intensity.

8. Reduce the programmed level until the display becomes unstable.

9. Repeat steps 5 and 6.

10. Repeat steps 7 and 8 until maximum sensitivity or a programmed level of 8 mV rms is reached. Maximum sensitivity must be less than 10 mV rms.

11. On the Front Panel of the UUT, set the ± switch to the – position.

12. Verify that on the UUT:

a. The + and – trigger indicators glow with equal intensity.

b. The GATE annunciator is flashing.

c. The display is a stable 1.000 ±1.

13. On the Front Panel of the UUT, rotate the Channel B Trigger Level control maximum clockwise.

14. Verify that:

a. On the UUT, the – trigger indicator is on and the + trigger indicator is off.

b. The DVM display is ≥ –1.5V rms.

15. On the Front Panel of the UUT, rotate the Channel B Trigger Level control counterclockwise as far it will go without switching to the PRESET position.

16. Verify that:

a. On the UUT, the + trigger indicator is on the the – trigger indicator is off.

b. The DVM display is ≤ +1.5V rms.

4-65. Time Base Adjustment

4-66. Use the following procedure to adjust the standard time base or any of the three optional time bases:

1. Connect the instrument to line power through a Variac set to local line voltage.

2. Allow the instrument to warmup at least 5 minutes with the case covers on. The longer the instrument has warmed up, the better.

3. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	FREQ A
RESOLUTION -	1 Hz
TRIGGER LEVEL (CH A) -	PRESET
ATTEN (CH A) -	X1
AC/DC (CH A) -	DC
± (CH A) -	+

4. On the Rear Panel of the UUT, set the REF switch to the INT position.

5. Connect the LF synthesizer to the Channel A input terminal on the UUT via a 50Ω termination and as short a length of RG-58 as possible.

6. Program the LF synthesizer for an output of 10.0 MHz at a level of 100 mV rms.

7. Verify that the UUT display is stable and reads about 10000.000 kHz.

8. On the Front Panel of the UUT, set the RESOLUTION control to the .1 Hz position.

9. Verify that on the UUT display, the OVFL annunciator illuminates.

10. Use the JFD 258 tuning tool to adjust the time base adjustment so that the UUT displayed vlaue is within 9999.9449 to 0000.0551*. Ideally, the display will be all zeros, indicating an exact alignment. Figure 4-10 shows the location of the time base adjustment hole in the bottom case cover off the UUT.

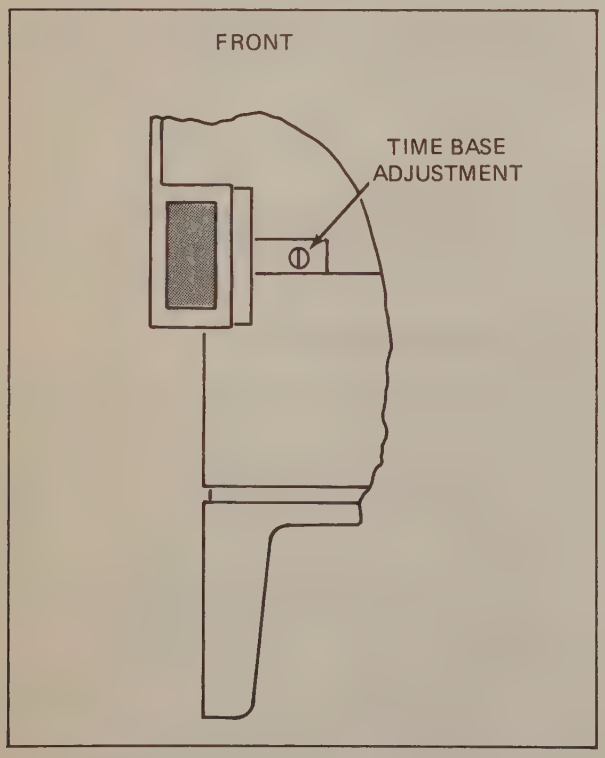


Figure 4-10. Time Base Adjustment Location

**NOTE*

The OVFL annunciator will illuminate every time the displayed value is 10000.0000 kHz or greater.

11. If the time base cannot be adjusted and is of the standard, free air type, remove the top case cover and look at the top of the time base pcb, perform the Coarse Time Base Adjustment procedure presented next in this section.

12. If the time base cannot be adjusted within specifications and is not of the type described in step 11, troubleshooting is indicated.

4-67. Coarse Time Base Adjustment

4-68. Some of the standard, free air, time bases have a coarse adjustment located on top of the A1A1 Time Base PCB. If the time base cannot be adjusted within proper limits using the previous time base calibration procedure, use the following procedure to coarse adjust the time base.

1. Connect the UUT to line power through a Variac set to the local line voltage.

2. Remove the top case cover (refer to the instrument access procedure presented earlier in this section).

3. On the Front Panel of the UUT, set the controls to the following positions:

FUNCTION -	FREQ A
RESOLUTION -	1 Hz
TRIGGER LEVEL (CH A) -	PRESET
ATTEN (CH A) -	X1
AC/DC (CH A) -	AC
± (CH A) -	+

4. On the Rear Panel of the UUT, set the REF switch to the INT position.

5. Use the JFD 258 tuning tool to adjust the fine time base adjustment to mid-range.

6. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50Ω termination.

7. Verify that the display is stable.

8. Using the JFD 258 tuning tool, adjust the coarse (top) time base adjustment until the display is as close as possible to 10000.000 kHz.

9. Connect the top case cover.

10. Wait at least 1/2 hour.

11. Perform the Time Base Adjustment procedure.

4-69. 100 MHz Time Base Adjustment

4-70. Use the following procedure for adjusting the 100 MHz time base on the 10-100 MHz Multipler PCB. Figure 4-11 shows the location of the test points and adjustments. The test points are labeled on the land pattern side of the pcb.

1. On the UUT, set the controls to the following positions:

FUNCTION -	PER A
RESOLUTION -	10 ns
SEP/COM -	SEP
TRIGGER LEVEL -	PRESET
MODE -	CONT
REF -	EXT
± -	+

2. Remove the top case cover of the UUT.

3. Connect LF synthesizer as shown in Figure 4-3, Part A.

4. Program the LF synthesizer for an output of 10 MHz at a level of 300 mV.

5. Connect the DMM, + to TP1 on the 10-100 MHz PCB; – to common.

6. Adjust C19 (on the 10-100 MHz PCB) for a DMM display of 6.3 ±0.3V.

7. Alter the LF synthesizer output to 9.7 and 10.3 MHz.

8. Verify that the DMM display goes to approximately 3V to 11V.

9. Disconnect the DMM.

10. Connect the oscilloscope through an X10 probe to U5-7 on the Main PCB.

11. Verify that the signal on the oscilloscope display is approximately 600 mV p-p on a dc offset of approximately 3.5V.

12. On the Front Panel of the UUT, set the FUNCTION and RESOLUTION controls to the positions shown in Table 4-11.

13. Verify that the 100 MHz signal is either present or absent from the oscilloscope display as listed in the table for each combination of control setttings.

14. Perform the Time Base Adjustment procedure.

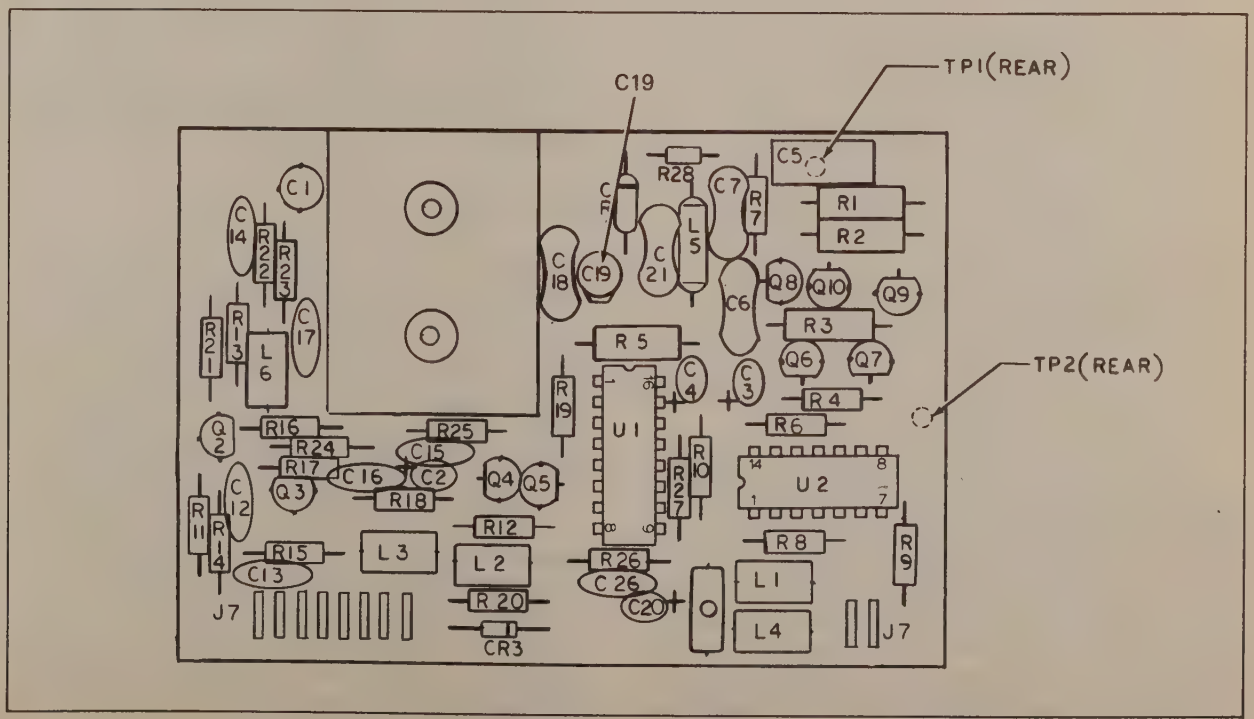


Figure 4-11. 10-100 MHz Multiplier PCB Adjustment and Test Point Location

Table 4-11. 100 MHz Time Base

FUNCTION CONTROL	RESOLUTION CONTROL	100 MHz SIGNAL	
		PRESENT	ABSENT
PER A	10 ns	X	
PER A	any but 10 ns		X
PER AVG A	any	X	
TI A-B	10 ns	X	
TI A-B	any but 10 ns		X
TIA A-B	any	X	

4-71. TROUBLESHOOTING

4-72. Introduction

4-73. The material in the remainder of this section is presented as a troubleshooting aid for the technician. If the instrument fails to perform as expected, select the CHK function. if the instrument display is incorrect, the fault is in the instrument. But, if the display is correct, the fault may not lie in the instrument. Ask the following questions:

1. Are the instrument controls set to the proper position?

2. Are the controls of associated equipment set to the proper positions?

3. Are the connections between the instrument and associated equipment correct?

4. Are the interconnecting cables in working order?

5. Is the associated equipment functioning properly?

6. Is the instrument designed to do what is being attempted?

If the answers to these questions are all "yes", then the fault is probably in the instrument.

4-74. The ease with which a technician isolates a fault in any instrument depends primarily upon just how well that technician knows the instrument. Sections 2 and 3 of this manual should be read and thoroughly understood before attempting to troubleshoot. As an aid to the troubleshooter, three additional subsections follow: Visual Inspection, Fault Isolation Guide, and Troubleshooting Techniques. The Visual Inspection should be performed first. The Fault Isolation Guide is a brief check of all instrument functions. The procedure should enable the technician to isolate the fault to a circuit or circuits. Once a suspect circuit is identified, the Troubleshooting Techniques provide the technician with suggestions for troubleshooting IC technology circuits.

4-75. When working with the instrument, either to troubleshoot or to make repairs, observe the warning given at the beginning of this section dealing with handling tehcniques and preventing static discharge damage. In addition, care should be taken when soldering as hidden damage to the instrument can be caused as well as obvious damage.

4-76. The instrument uses three basic types of logic: ECL, TTL, and CMOS. The circuits handling the high frequency signals employ Emitter Coupled Logic (ECL) because of its faster switching capability. Positive ECL is used to reduce interfacing problems. On the schematics in Section 8, ECL logic terms are usually identified by a prime (') symbol immediately following the term. Circuitry using CMOS IC's work at CMOS logic levels. The remainder of the instrument employs Transistor-Transistor Logic (TTL). Table 4-12 lists the high and low logic levels for each of the three types of logic used in the instrument.

Table 4-12. Instrument Logic Levels

LOGIC TYPE	LOGIC 1	LOGIC 0
TTL	>2.5V	<0.6V
ECL	>4.1V	<3.2V
CMOS	>3.5V (>70% of supply)	<1.5V (<30% of supply)

4-77. Visual Inspection

4-78. Visual inspection can sometimes quickly locate instrument faults saving the technician the time usually consumed in extensive troubleshooting. Use the Disassembly procedure presented earlier in this section to remove the top case cover. Carefully inspect the instrument inside and out. Check for loose or broken wires and component leads, improperly seated plug-in assemblies, physically damaged component, discoloration due to arcing, etc. Shorted IC's usually have a small bubble or discoloration at the center of the package. Shorted capacitors or resistors in short paths are often discolored or burnt. Abusively high overloads may blow carbon composition resistors, glass diodes, ceramic capacitors, thermistors, etc into fragments. These symptoms or anything that looks suspect should be carefully checked before proceeding with involved troubleshooting.

4-79. Fault Isolation Guide

4-80. The Fault Isolation Guide is a simplified check of instrument performance. It is intended to direct the troubleshooter to the defective circuit or circuits. There are three basic cases of improper operation:

1. The instrument will not turn on. Use the Power Up procedure.

2. The instrument turns on but the problems seem to be spread thoughout the instrument or erratic. This may be due to any of a number of power supply related problems. Use the Power Up procedure.

3. The instrument has a problem in one or more function or range. Use the Improper Operation procedure.

4-81. POWER UP PROCEDURE

CAUTION

Line power voltage is present from the power cord throughout the primary circuit or the main power transformer. Do not contact this voltage.

4-82. If the instrument cannot be turned on, the problem may lie in several areas: the line power used may not be present, the AC POWER switch may be in the OFF position, the main power fuse, F1, may be blown, or there may be a power supply problem. Power supply problems can be caused both by faults in the power supply circuitry and by shorts in the instrument loading the power supply down. Points to consider when attempting to isolate power problems are listed below. If the UUT will operate but the symptoms are erratic or widespread, seemingly disassociated then go directly to item number 6.

1. Insure that line power is present at the receptacle being used.

2. Insure that the Rear Panel AC POWER switch is in the ON position.

3. Check F1, the main power fuse.

4. Make continuity measurements between chassis common and the three pins of the power receptacle. The ground pin to common should be zero volts. The other two pins to common should be infinity.

5. Make the continuity measurement between the two non-ground pins of the Rear Panel power receptacle. (The AC POWER switch should be in the ON position.) There should be some slight resistance because the measurement is taken through the primary windings of the main power transformer.

6. Measure the power supply voltages at TP1, TP2, TP3 and TP4 with the Front Panel POWER ON/STBY switch in both positions. Use E1 for the common reference when making these measurements. If all voltages are within the limits listed in the Power Supply Voltage Adjustment procedure, proceed to item 7. If one or more voltage is incorrect when the POWER ON/STBY switch is in the STBY position, the problem is in the power supply, proceed to item 6, Part A. If one or more voltages is/are incorrect only when the POWER ON/STBY switch is in the ON position, the fault does not lie in the power supply, proceed to item 6, Part B.

a. Problems in the power supply can be tracked down using conventional methods, but remember that:

1) The –5V supply "tracks" the +5V supply so if the +5V supply has a problem, it will affect both power suppplies.

2) The +5V supply "tracks" the +12V supply, so if the +12V supply has a problem, it will affect the +12V, +5V and –5V supplies.

3) The –12V supply, after the rectifier, CR1, is independent of the other supplies. Problem in all four power supplies indicates that the fault lies in the primary circuit, transformer, or CR1.

b. Shorts that load down a particular power supply can best be isolated by disconnecting the pcbs that plug into the Main PCB, one at a time. Remember to turn the instrument off before disconnecting or connecting cables, plugs or pcbs. If the short cannot be located by unplugging pcbs, use the current probe tracing procedure described in Troubleshooting Techniques. Start at the output of the power supply that is loaded down. This is the logical point and also gives the approximate amount of current drawn by the short.

4-83. IMPROPER OPERATION PROCEDURE

4-84. The Improper Operation Procedure is a simple dynamic test of the instrument. The procedure provides a speedy overall view that is interpreted by Table 4-13 to guide the technician to the most likely circuits. Additional information can be gained to aid troubleshooting by performing the Performance Checks indicated by the results of the procedure. The UUT can pass all parts of the procedure and still have faults. Should the UUT pass the procedure, do the Performance Checks. Use the following

steps to perform the Improper Performance Procedures. Perform the Improper Operation Procedure as follows:

1. Set the instrument controls as follows:

RESOLUTION -	1 kHz
SEP/COM -	SEP
FILTER -	OUT
CHANNEL A & B	
TRIGGER LEVEL -	PRESET
ATTEN -	X1
AC/DC -	DC
± -	+
REF -	INT

2. Connect the LF synthesizer to the Channel A input terminal of the UUT via a 50Ω termination.

3. Program the LF synthesizer for an output of 1 MHz at a level of 100 mV rms.

4. To check the FREQ A function:

   a. Set the FUNCTION control to the FREQ A position.

   b. Verify that the GATE annunciator is flashing and that the display is 1.000 MHz.

5. To check the CPM X100A function:

   a. Set the FUNCTION control to the CPM X100A position.

   b. Verify that the GATE annunciator is flashing and that the display is 600000.

6. To check the FREQ C function: Refer to Section 6.

7. To check the RATIO A/B function:

   a. Set the FUNCTION control to the RATIO A/B position.

   b. Set the SEP/COM switch to the COM position.

   c. Verify that the GATE annunciator is flashing and that the display is 1.0.

   d. Set the SEP/COM switch to the SEP position.

8. To check the PER A function:

   a. Set the FUNCTION control to the PER A position.

   b. Verify that the GATE annunciator is flashing and that the display is 0.0010 msec.

   c. Set the RESOLUTION control to the 10 ns position.

   d. Verify that the GATE annunciator is flashing and that the display is 1.00 μsec. (R0 check.)

9. To check the PER AVG A function:

   a. Set the FUNCTION switch to the PER AVG A position.

   b. Verify that the GATE annunciator is flashing and the display is 0.00100 msec.

10. To check the TI A-B function:

    a. Set SEP/COM switch to COM and the FUNCTION control to the TI A-B position.

    b. Set the Channel B ± control to the – position.

    c. Verify that the GATE annunciator is flashing and that the display is 0.50 μsec.

    d. Set the RESOLUTION control to the 100 ns position.

    e. Verify that the GATE annunciator is flashing and that the display is 0.0005 msec.

11. To check the TIA A-B function:

    a. Set the FUNCTION control to the TIA A-B position.

    b. Verify that the GATE annunciator is flashing and that the display is 0.000500 msec.

12. To check the TOT A B function:

    a. Set the SEP/COM switch to the SEP position.

    b. Rotate the Channel B TRIGGER LEVEL control maximum counterclockwise.

    c. Set the FUNCTION control to the TOT A B position.

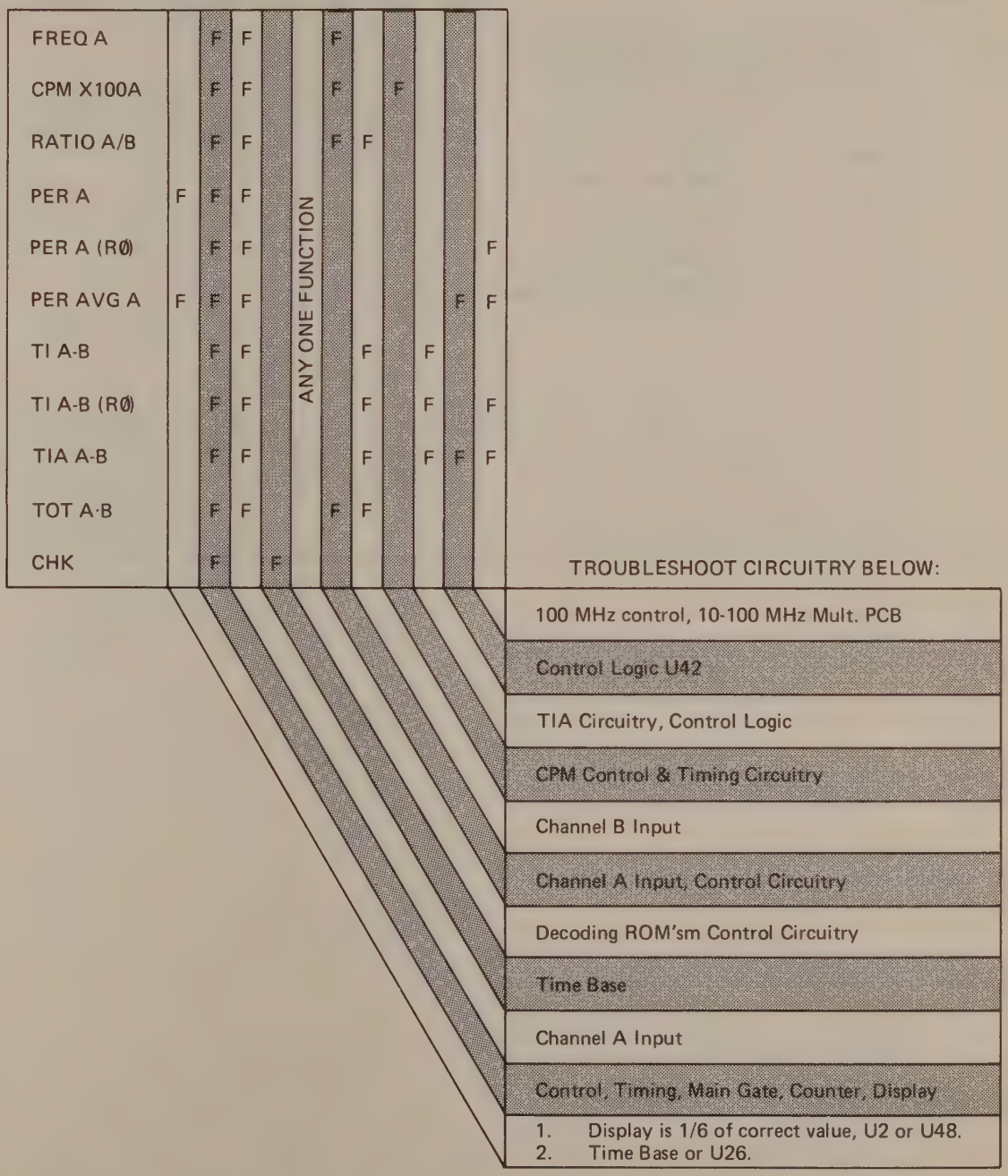
    d. Press and release the RESET button on the Front Panel of the UUT.

    e. Verify that all zeros is displayed.

    f. Rotate the Channel B TRIGGER LEVEL control maximum clockwise.

    g. Verify that a count begins to accumulate in the display and the GATE annunicator is lit.

Table 4-13. Fault Isolation Guide Interpretation



4-85. Troubleshooting Techniques

4-86. There are several techniques that can be used to isolate a fault in the instrument. The techniques are discussed below by type.

4-87. CURRENT TRACING

4-88. Current Tracer probes, such as the HP 547A, are usually the best way to locate shorts in the instrument. If the short is so bad that the power supply is loaded down, the Performance Checks or Fault Isolation Guide may not provide any help in isolating the faulty circuit. Starting at the output of the loaded power supply, logically move the Current Tracer through the instrument until the short is found. Sometimes the short is minor and is located between two or more logic gates as shown in Figure 4-12. The Current Tracer will glow brightest at the terminal of the shorted gate.

4-89. HEAT AND COLD

4-90. A fast and effective method of locating the faulty area in the instrument is by alternately heating and cooling areas in the instrument with a heat gun and freon spray. This check can be used on large areas or even individual components. IC's can open or short internally and this method of troubleshooting can be especially effective.

4-91. LOGIC CLIP

4-92. Logic clips, such as the John Fluke Testclip 200, provide the troubleshooter with visual indication of the logic levels in the instrument as the instrument operates. This test device is easier to use (it clips onto the IC) than such test equipment as an oscilloscope and allows all inputs and outputs to be observed simultaneously.

4-93. TEMPERATURE

4-94. Shorted components overheat. Temperature can be measured with the Fluke 80T-150 and any of its associated DMMs.

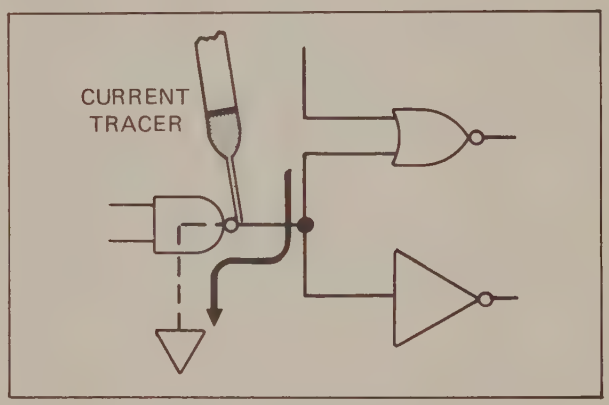


Figure 4-12. Current Tracing

Section 5
List of Replaceable Parts

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* See Final Assembly

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the Options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed first by reference designation and second by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists included the following information:

1. Reference Designation or Item Number.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

5. Manufacturer's Part Number or Type.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

8. The Use Code: This entry indicates a note number. The corresponding note will be at the end of that table.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.

2. FLUKE Stock Number.

3. Description.

4. Reference Designation or Item Number.

5. Printed Circuit Board Part Number.

6. Instrument Model and Serial Number.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 5-1. 7261A Final Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
	⊗FINAL ASSEMBLY, 7261A FIGURE 5-1 (7261A-5001)						
A1	MAIN PCB ASSY	475152	89536	475152	1		
A2	FRONT PANEL PCB ASSEMBLY	476028	89536	476028	1		
A3	SIGNAL CONDITIONER, MATCHED	479964	89536	479964	2		1
A4	SIGNAL CONDITIONER, MATCHED	479964	89536	479964	REF		
A5	TIMEBASE PCB ASSEMBLY	538660	89536	538660	1		
A6	10-100 MHZ MULTIPLIER PCB ASSEMBLY	475855	89536	475855	2		
F1	FUSE, SLO-BLO				1	5	
	3/8 AMP (100V, 120V)	109264	71400	MDL3-8			
	3/16 AMP (220V, 240V)	501098	71400	MDL3-16			
	FUSE, SLO-BLO (METRIC)				1	5	
	3/8 AMP (100V, 120V)	505180	89536	505180			
	3/16 AMP (220V, 240V)	505164	89536	505164			
H1	GROMMET	104273	72653	7582	1		
H2	LUG, SOLDER	167015	73734	118100	1		
H3	NUT, HEX 4-40	110635	73734	8003NP	2		
H4	NUT, HEX, 15/32, 32NC, 2B	110916	73734	17-200-NP	2		
H5	NUT, HEX, 6-32	152819	78199	511-061800-00	4		
H6	SCREW, PHP, 4-40 X 1/2"	152132	73734	19026	2		
H7	SCREW, PHP, 4-40 X 1/2	256172	89536	256172	2		
H8	SCREW, SEMS, 6-32 X 3/8	177022	89536	177022	2		
H9	SCREW, FHP, 6-32 X 5/8	114876	89536	114876	6		
H10	SCREW, THREAD-FORMING, 6-20 X 3/8	288266	89536	288266	1		
H11	SCREW, TAPTITE, BLACK, 6-32 X 3/8	485227	89536	485227	6		
H12	WASHER, EXT. LK	175943	89536	175943	1		
H13	WASHER, LK. #4	110395	89536	110395	2		
H14	WASHER, INT. LK	110403	73734	99402	2		
H15	WASHER, SHOULDER	485417	86928	5607-50	2		
J4	CONN, BNC, (MARKER OUT)	152033	95712	30355-1	4		
J5	CONN, BNC (TRIG. LEVEL OUT)	152033	95712	30355-1	REF		
J6	CONN, BNC (10 MHZ REF. IN.)	152033	95712	30355-1	REF		
J7	CONN, BNC (10 MHZ REF. OUT)	152033	95712	30355-1	REF		
KIT	RECOMMENDED SPARE PARTS KIT (7261A)	583492	89536	583492	AR		
MP1	BUSHING, INSULATED	488429	89536	488429	2		
MP2	PUSHBUTTON, BLUE	486473	89536	486473	1		
MP3	PUSHBUTTON, GREY	436478	89536	436478	1		
MP4	PUSHBUTTON, GREEN	486498	89536	486498	1		
MP6	COVER, BOTTOM ASSY	489302	89536	489302	1		
MP7	COVER, CONNECTOR	488395	89536	488395	1		
MP8	HEAT SINK	473868	89536	473868	1		
MP9	INSULATOR, XSTR	534453	89536	534453	1		
MP10	LABEL, WARNING	386250	89536	386250	1		
MP11	KNOB ASSEMBLY	490755	89536	490755	3		
MP12	NAMEPLATE, SERIAL	472795	89536	472795	1		
MP13	LATCH	467548	89536	467548	1		
MP14	COVER, TOP	509414	89536	509414	1		
MP15	DECAL, SPEC.	483057	89536	483057	1		
MP16	FUSE DECAL (NOT SHOWN)	487330	89536	487330	1		

Table 5-1. 7261A Final Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
MP17	PLUG BUTTON	398206	89536	398206	1		
MP18	INSULATOR, XFRM	507517	89536	507517	1		
Q1	XSTR, SI, NPN, PWR	325761	09214	D44C5	1	1	
S9	SWITCH, TOGGLE, SPDT	493825	54659	UL-11	1	1	
T1	TRANSFORMER	486548	89536	486548	1		
U4	IC, ECL, EDGE TRIGGERED, J-K F/F	402743	07263	402743	1	1	
U8	IC, QUAD, DIFFERENTIAL LINE RECEIVER	483933	01295	AM26L32N	1	1	
U15	IC, DIGITAL MOS	473215	89536	417215	1	1	
U48Ø	IC, P/MOS (INSTALLED IN TEST)	460063	89536	460063	1	1	
U49	IC, LINEAR, NEG VOL REGULATOR	381655	04713	MC7912C	1	1	
U50	IC, LINEAR, VOL REG, FXD VOL, 12V	413195	04713	MC7812CP	1	1	
W1	LINE CORD (NOT SHOWN)	343723	70903	343723	1		
W2	CABLE ASSEMBLY (GREEN)	504068	89536	504068	1		
W3	CABLE ASSEMBLY (WHITE)	504050	89536	504050	1		
W4	CABLE ASSEMBLY (BLACK)	504076	89536	504076	1		
XF1	FUSEHOLDER, BODY W/NUT	460329	89536	460329	1		
XF1-1	FUSEHOLDER, CAP	460238	89536	460238	1		
XF1-2	FUSEHOLDER, CAP (METRIC)	461020	89536	461020	1		
	INSTRUCTION MANUAL (7261A)	487512	89536	481512			

1 A3/A4 MUST BE ORDERED AT PCB LEVEL ONLY. A3 IS MATCHED TO R44, A4 IS MATCHED TO R68 ON A1 MAIN PCB ASSY. NO PARTS BREAKDOWN WILL BE LISTED. FOR REPLACEMENT SEE FINAL ASSEMBLY FIGURE 5-1.

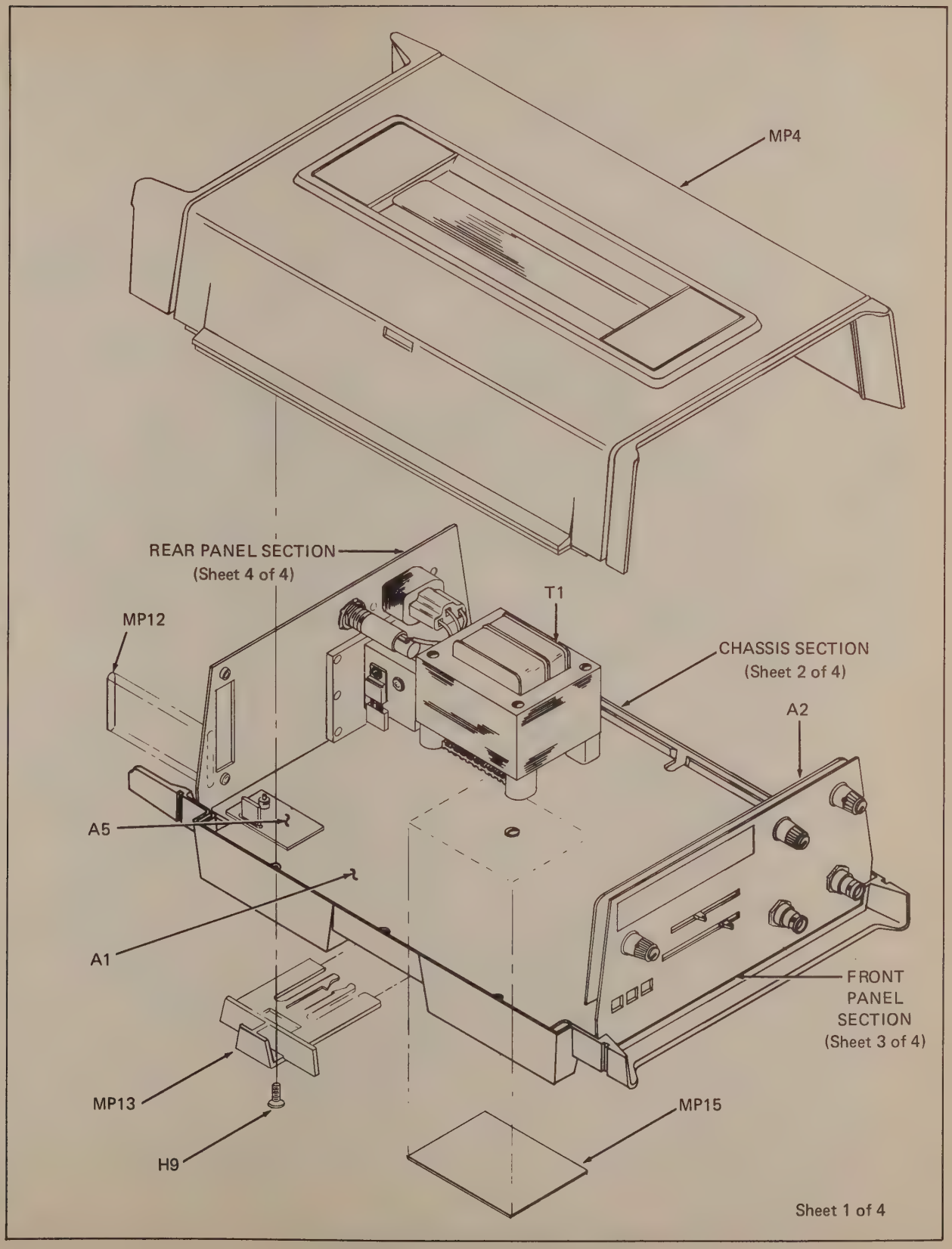


Figure 5-1. 7261A Final Assembly

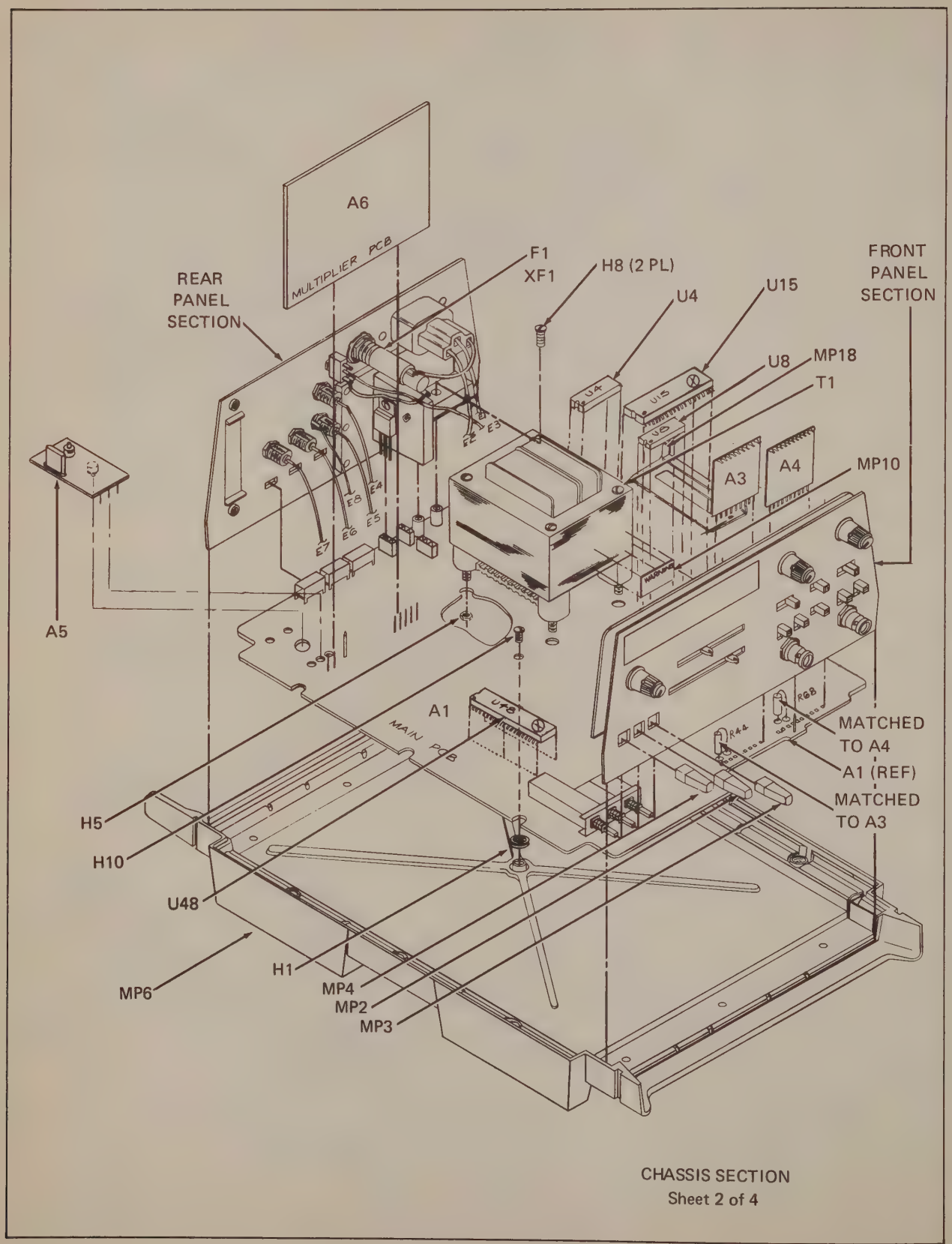
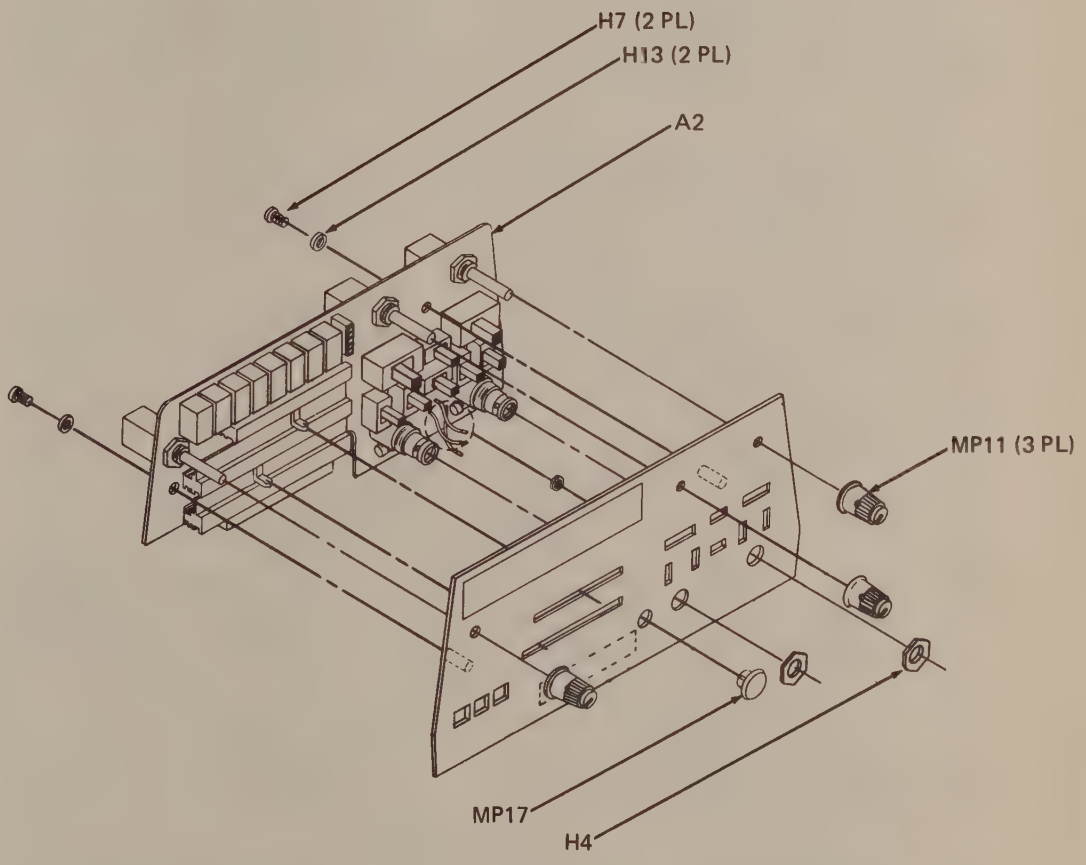


Figure 5-1. 7261A Final Assembly (cont)



FRONT PANEL SECTION
Sheet 3 of 4

Figure 5-1. 7261A Final Assembly (cont)

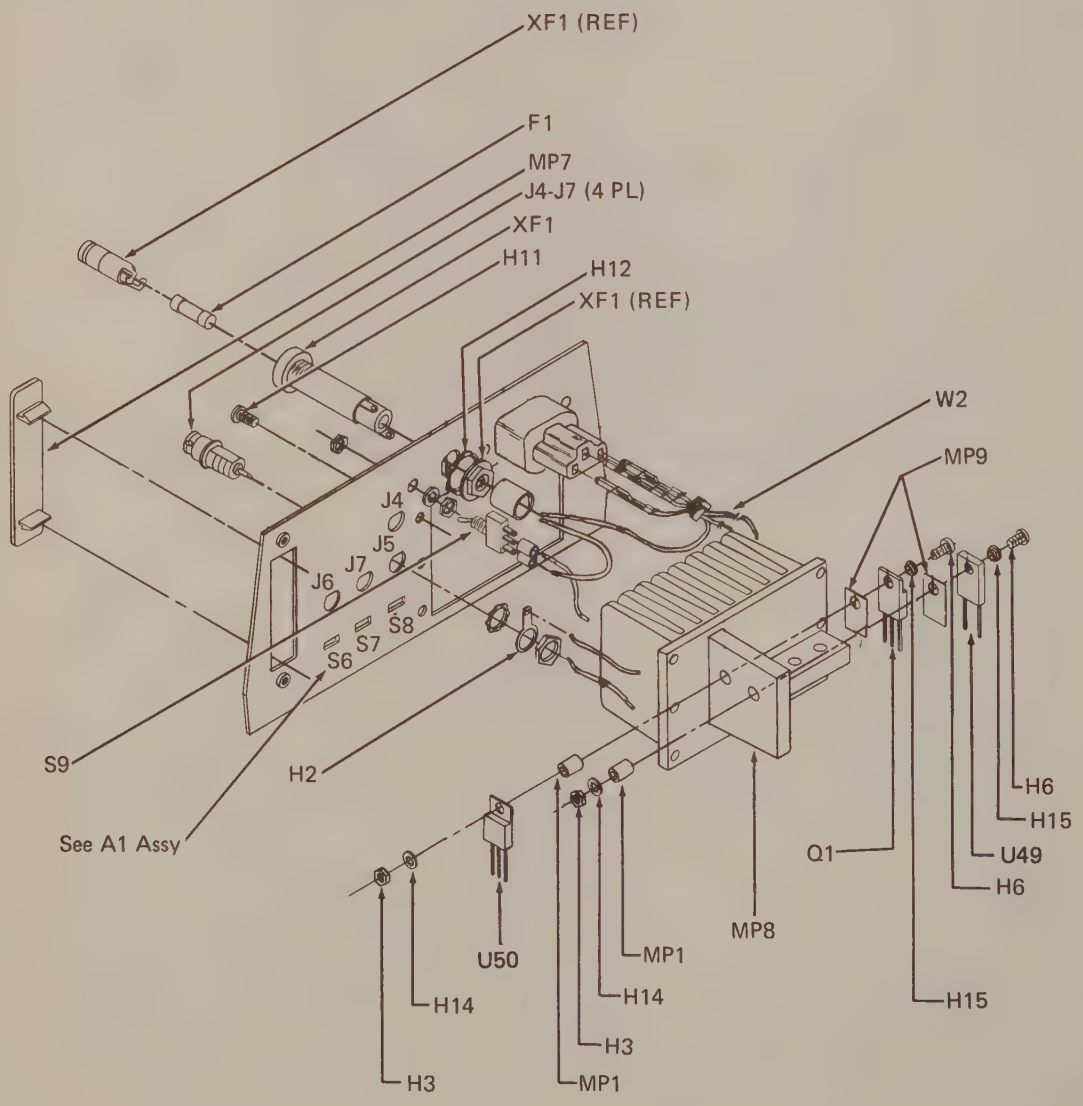


Figure 5-1. 7261A Final Assembly (cont)

Table 5-2. A1 Main PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A1Ⓐ	MAIN PCB ASSEMBLY FIGURE 5-2 (7261A-4001T)	475152	89536	475152	REF		
C1	CAP, ELECT, 470 UF -10/+75%, 35V	478792	89536	478792	2		
C2	CAP, ELECT, 470 UF -10/+75%, 35V	478792	89536	478792	REF		
C3	CAP, ELECT, 1000 UF -10/+75%, 25V	478826	89536	478826	1		
C4	CAP, ELECT, 6800 UF -10/+100%, 15V	478784	89536	478784	1		
C5	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	2		
C6	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	REF		
C7	CAP, CER, 3300 PF +/-20%, 1000V	106674	56289	C040B102H332M	1		
C8	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	1		
C9	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	2		
C10	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	28		
C11	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C12	CAP, MICA, 220 PF +/-5%, 500V	170423	72136	DM15F221J	2		
C13	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253M	1		
C14	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C15	CAP, CER, 0.1 UF +/-GMV, 10V	368647	71490	UK10-104	2		
C16	CAP, CER, 0.1 UF +/-GMV, 10V	368647	71490	UK10-104	REF		
C17	CAP, TA, 39 UF +/-20%, 20V	358234	56289	196D396X0020PE4	1		
C18	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	1		
C19	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	1		
C20	CAP, CER, .0068 UF +/-10%, 50V	342881	80031	75F1R5A687	1		
C21	CAP, CER, 0.0012 UF +/-10%, 500V	106732	71590	CF122	2		
C22	CAP, CER, 0.0012 UF +/-10%, 500V	106732	71590	CF122	REF		
C23	CAP, MICA, 220 PF +/-5%, 500V	170423	72136	DM15F221J	REF		
C24	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C25	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C26	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C27	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C28	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C29	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C30	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C31	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C32	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C33	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C34	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C35	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C36	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C37	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C38	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C39	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C40	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C41	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C42	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C43	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C44	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C45	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C46	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C47	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
C48	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C49	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C50	CAP, VAR, 5 PF-50 PF VAR	321117	56289	GKB50,000	1		
C51	CAP, TA, 330 UF +/-10%, 6V	193011	56289	150D331X952	1		
CR1	DIODE, RECTIFIER BRIDGE, 1.5 AMP	296509	21845	F903C-22	1	1	
CR2	DIODE, RECTIFIER BRIDGE, 2 AMP	392910	21845	F903B-21G	1	1	
CR3	DIODE, RECTIFIER, SI, 2 AMP	347559	05277	1N5400	2	1	
CR4	DIODE, RECTIFIER, SI, 2 AMP	347559	05277	1N5400	REF		
CR5	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	3	1	
CR6	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	REF		
J2	SOCKET, PCB MTG	376418	22526	75060-007	24		
J3	SOCKET, PCB MTG	376418	22526	75060-007	REF		
J6	CONNECTOR, RECEPTACLE	291948	00779	583650-7	1		
	KEY, CONNECTOR	424572	00779	530286-2	1		
JB1	CONNECTOR, POST	379438	00779	86144-5	17		
JB2	CONNECTOR, POST	379438	00779	86144-5	1		
L1	CHOKE, 6-TURN	320911	89536	320911	1		
MP1	GUIDE, PIN (NOT SHOWN)	375840	89536	375840	3		
MP2	STANDOFF, SWAGED (NOT SHOWN)	528661	89536	528661	1		
P1	CONNECTOR, POST	379438	00779	86144-5	96		
P4	CONNECTOR, POST	379438	00779	86144-5	REF		
P7	CONNECTOR, POST	379438	00779	86144-5	REF		
P8	CONNECTOR, POST	379438	00779	86144-5	REF		
Q2	XSTR, SI, NPN	346916	07263	2N3904	1	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	3	1	
Q4	XSTR, SI, PNP	325753	09214	D45C5	1	1	
Q5	XSTR, SI, PNP	195974	04713	2N3906	2	1	
Q6	XSTR, PNP, HI-SPEED SWITCH (SELECTED)	369629	89536	369629	4	1	
Q7	XSTR, PNP, HI-SPEED SWITCH (SELECTED)	369629	89536	369629	REF		
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, PNP, HI-SPEED SWITCH (SELECTED)	369629	89536	369629	REF		
Q10	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q12	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q13	XSTR, PNP, HI-SPEED SWITCH (SELECTED)	369629	89536	369629	REF		
R1	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	6		
R2	RES, WW, PW, 0.2 +/-5%, 2W	352914	89536	352914	1		
R3	RES, MTL. FILM, 3.32K +/-1%, 1/8W	312652	91637	CMF553321F	1		
R4	RES, VAR, CER, 500 +/-10%, 1/2W	325613	89536	325613	1		
R5	RES, MTL. FILM, 2.21K +/-1%, 1/8W	347476	91637	CMF552211F	1		
R6	RES, COMP, 33 +/-10%, 1/2W	108456	01121	EB3301	1		
R7	RES, MTL. FILM, 4.99K +/-1%,, 1/8W	168252	91637	CMF554991F	2		
R8	RES, COMP, 180 +/-5%, 1/4W	147942	01121	CB1815	2		
R9	RES, COMP, 1.8K +/-5%, 1/4W	175042	01121	CB1825	3		
R10	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	1		
R11	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	10		
R12	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R13	RES, COMP, 4.7 +/-5%, 1/4W	193359	01121	CB47G5	1		
R14	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	3		
R15	RES, MTL. FILM, 68.1 +/-1%, 1/8W	305995	91637	CMF5568R1F	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R16	RES, MTL. FILM, 191 +/-1%, 1/8W	325639	91637	CMF551910F	1		
R17	RES, MTL. FILM, 4.99K +/-1%, 1/8W	168252	91637	CMF554991F	REF		
R18	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R19	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	1		
R20	RES, COMP, 1.2K +/-5%, 1/4W	190371	01121	CB1225	1		
R21	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	8		
R22	RES, DEP. CAR, 13K +/-5%, 1/4W	441402	80031	CR251-4-5P13K	2		
R23	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R24	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R25	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R26	RES, DEP. CAR, 20K +/-5%, 1/8W	441477	80031	CR251-4-5P20K	3		
R27	RES, DEP. CAR, 20K +/-5%, 1/8W	441477	80031	CR251-4-5P20K	REF		
R28	RES, DEP. CAR, 20K +/-5%, 1/8W	441477	80031	CR251-4-5P20K	REF		
R29	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R30	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	8		
R31	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	2		
R32	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	REF		
R33	RES, COMP, 470K +/-5%, 1/4W	188441	01121	CB4745	1		
R34	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R35	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R36	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
R37	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	2		
R38	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R39	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R40	RES, DEP. CAR, 470 +/-5%, 1/4W	170712	01121	CB1215	REF		
R41	RES, DEP. CAR, 100 +/-5%, 1/4W	346771	80031	CR251-4-5P100E	2		
R42	RES, DEP, CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R43	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R44	RES, MATCHED TO A3 ASSEMBLY 1				1		
R45	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R46	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R47	RES, VAR, CER, 10K +/-20%, 1/2W	226092	80031	ET50W-103	2		
R48	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R49	RES, VAR, CER, 10K +/-20%, 1/2W	226092	80031	ET50W-103	REF		
R50	RES, COMP, 1.8K +/-5%, 1/4W	175042	01121	CB1825	REF		
R51	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R52	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R53	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	2		
R54	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	1		
R55	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R56	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R57	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R58	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R59	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R60	RES, COMP, 33 +/-5%, 1/4W	175034	01121	CB3305	REF		
R61	RES, COMP, 51 +/-5%, 1/4W	221879	01121	CB5105	1		
R62	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R63	RES, DEP. CAR, 1.8K +/-5%, 1/4W	441444	80031	CR251-4-5P1K8	1		
R64	RES, COMP, 180 +/-5%, 1/4W	147942	01121	CB1815	REF		
R65	RES, DEP. CAR, 270 +/-5%, 1/4W	348789	80031	CR251-4-5P270E	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R66	RES, DEP. CAR, 13K +/-5%, 1/4W	441402	80031	CR251-4-5P13K	REF		
R67	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R68	RES, MATCHED TO A4 ASSEMBLY 1				1		
R69	RES, COMP, 22 +/-5%, 1/4W	147884	01121	CB2235	1		
R70	RES, COMP, 1.8K +/-5%, 1/4W	175042	01121	CB1825	REF		
R71	RES, DEP. CAR, 300 +/-5%, 1/4W	441519	80031	CR251-4-5P300E	1		
R72	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
R73	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R74	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R75	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R77	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R78	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	1		
R79	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R80	RES, COMP, 20 +/-5%, 1/4W	246728	01121	CB2035	1		
R81	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	REF		
R82	RES, DEP. CAR, 1.3 +/-5%, 1/4W	442012	80031	CR251-4-5P1E3	1		
R83	RES, DEP. CAR, 27K +/-5%, 1/4W	441501	80031	CR251-4-5P27K	1		
RN1	RESISTOR NETWORK, 4.7K	412916	89536	412916	2	1	
RN2	RESISTOR NETWORK, 4.7K	412916	89536	412916	REF		
RN3	RESISTOR NETWORK, 510, 6-PIN	459974	89536	459974	3	1	
RN4	RESISTOR NETWORK, 510, 6-PIN	459974	89536	459974	REF		
RN5	RESISTOR NETWORK, 510, 6-PIN	459974	89536	459974	REF		
RN6	RESISTOR NETWORK, 510, 10-PIN	478800	89536	478800	1	1	
RN7	RESISTOR NETWORK, 510, 8-PIN	447482	89536	447482	1	1	
RN8	RESISTOR NETWORK, 39, 14-PIN	412866	89536	412866	1	1	
RN9	RESISTOR NETWORK, 4.7K +/-2%, 1/8W	484063	89536	484063	1	1	
S1-S3	PUSHBUTTON ASSY	473991	89536	473991	1		
S4	SWITCH, SLIDE, DPDT	234278	89536	234278	2	1	
S5	SWITCH, SLIDE, DPDT	234278	89536	234278	REF		
S6	SWITCH, SLIDE	354878	89536	354878	3	1	
S7	SWITCH, SLIDE	354878	89536	354878	REF		
S8	SWITCH, SLIDE	354878	89536	354878	REF		
U1	IC, TTL, W/SCHMITT TRIG DUAL MNSTBL/MLTV	404202	01295	SN74LS221N	2	1	
U2	IC, TTL, AND-OR-GATES	412981	01295	SN74LS51N	2	1	
U3	IC, TTL, INVERTERS	418004	01295	SN74S04N	1	1	
U5	IC, ECL, QUAD, 2-INPUT NOR	380881	04713	MC10102P	2	1	
U6	IC, ECL, DUAL 4-5 INPUT, OR/NOR GATE	454967	04713	MC10109P	1	1	
U7	IC, ECL, DUAL TYPE D MSTR-SLAVE F/F	454959	04713	MC10131P	2	1	
U9	IC, ECL, DUAL TYPE D MSTR-SLAVE F/F	454959	04713	MC10131P	REF		
U10	IC, TTL, QUAD, 2-INPUT, POS NAND GATES	393033	01295	SN74LS00N	1	1	
U11	IC, TTL, QUAD, 2-INPUT, POS NOR GATES	393041	01295	SN74LS02N	1	1	
U12	IC, TTL, HEX INVERTERS	393058	01295	SN74LS04N	3	1	
U13	IC, TTL, SCHTKY, DUAL J-K EDGE-TRIG F/F	363440	01295	SN74S112N	2	1	
U14	IC, TTL, DECADE DIVIDER	402545	01295	SN74LS90N	1	1	
U15	SEE FINAL ASSY.						
U16	IC, ECL, TRIPLE, 2-INPUT, LINE RECEIVER	527242	89536	527242	1	1	
U17	IC, TTL, DATA SELECTOR/MLTPLXRS	393173	01295	SN74LS151N	1	1	
U18	IC, TTL, DUAL D, EDGE-TRIG, F/F	393124	01295	SN74LS74N	1	1	
U19	IC, TTL, DUAL J-K F/F	363440	01295	SN74S112N	1	1	
U20	IC, LINEAR, DUAL TIMER	387407	18324	NE556A	1	1	

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
U21	IC, TTL, DUAL J-K EDGE-TRIG F/F	363440	01295	SN74S112N	REF		
U22	IC, TTL, TRI-STATE OCT/BUFF	429902	12040	DM81LS95N	2	1	
U23	IC, ECL, QUAD, 2-INPUT NOR	380881	04713	MC10102P	REF		
U24	IC, LINEAR OP AMP	363515	12040	LM301AN	2	1	
U25	IC, LINEAR OP AMP	363515	12040	LM301AN	REF		
U26	IC, TTL, DECADE DIVIDER	483594	01295	SN74LS390N	1		
U27	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U28	IC, TTL, TRIPLE, 3-INPUT, POS AND GATES	393082	01295	SN74LS11N	1	1	
U29	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U30	IC, TTL, W/SCHMITT-TRIG DUAL MNSTBL/MLTV	404202	01295	SN74LS221N	REF		
U31	IC, TTL, TRIPLE, 3-INPUT, POS NOR GATES	393090	01295	SN74LS27N	1	1	
U32	IC, TTL, AND-OR-INVERT GATES	495473	01295	SN74S51N	1		
U33	IC, TTL, 8-BIT SHIFT REG.	408732	01295	SN74LS164N	1	1	
U34Ⓓ	IC, C-MOS, 8-INPUT, NOR GATE	408781	04713	MC14078CP	1	1	
U35	IC, HEX, DIGIT DRIVER	429506	12040	DS75492N	2	1	
U36	IC, HEX, DIGIT DRIVER	429506	12040	DS75492N	REF		
U37	IC, TTL, QUAD, 2-IN, EXCLS-OR GATES	408237	01295	SN74LS86N	1	1	
U38	IC, TTL, DIVIDE X 12 CNTRS	473843	01295	SN74LS92N	1	1	
U39	IC, TTL LO-PW SCHTKY 4-1LINE SLCTR/MTPLX	393181	01295	SN74LS153N	1	1	
U40	IC, TTL, AND-OR-INVERT GATES	412981	01295	SN74LS51N	REF		
U41	IC, BIPOLAR 256 BIT ROM, YEL DOT	477307	89536	477307	1	1	
U42	IC, BIPOLAR 256 BIT ROM, WHT DOT	477315	89536	477315	1	1	
U43	IC, BIPOLAR 256 BIT ROM, GRN DOT	477323	89536	477323	1	1	
U44Ⓓ	IC, C-MOS, TRI-STATE HEX BFRS 2 & 4 BIT	483800	04713	SN74LS367N	1	1	
U45	IC, TTL, TRI-STATE OCT/BUFF	429902	12040	DM81LS95N	REF		
U46Ⓓ	IC, C-MOS, BCD TO 7-SGMNT LTCH/DCDR/DRVR	429522	04713	MC14511CP	1	1	
U47	IC, TTL, SCHMITT-TRGR	483180	01295	SN74LS14N	1	1	
U48Ⓓ	IC, P-MOS, COUNTER PROGRAM LOGIC	SEE	FINAL	ASSY.	1	1	
W1	CABLE ASSY, COAX	489351	89536	489351	1		
XQ1	SOCKET, XSTR, 3-PIN	402958	09922	D1LB-28P-108	3		
XQ2	SPACER, XSTR	152207	07047	10123 DAP	1		
XU4	SOCKET, 16-PIN	370312	91506	316-AG39D	3		
XU8	SOCKET, 16-PIN	370312	91506	316-AG39D	REF		
XU15	SOCKET, IC, 40-PIN	429282	09922	D1LB40P-108	2		
XU16	SOCKET, 16-PIN	370312	91506	316-AG39D	REF		
XU48	SOCKET, IC, 40-PIN	429282	09922	D1LB40P-108	REF		
XU49	SOCKET, XSTR, 3-PIN	402958	09922	D1LB-28P-108	REF		
XU50	SOCKET, XSTR, 3-PIN	402958	09922	D1LB-28P-108	REF		

R44 AND R68 ARE MATCHED RESISTORS TO THE A3/A4 SIGNAL CONDITIONER PCB ASSEMBLIES. THESE RESISTORS ARE INCLUDED WHEN ORDERING A3 OR A4 AS THE MATCHED SET.

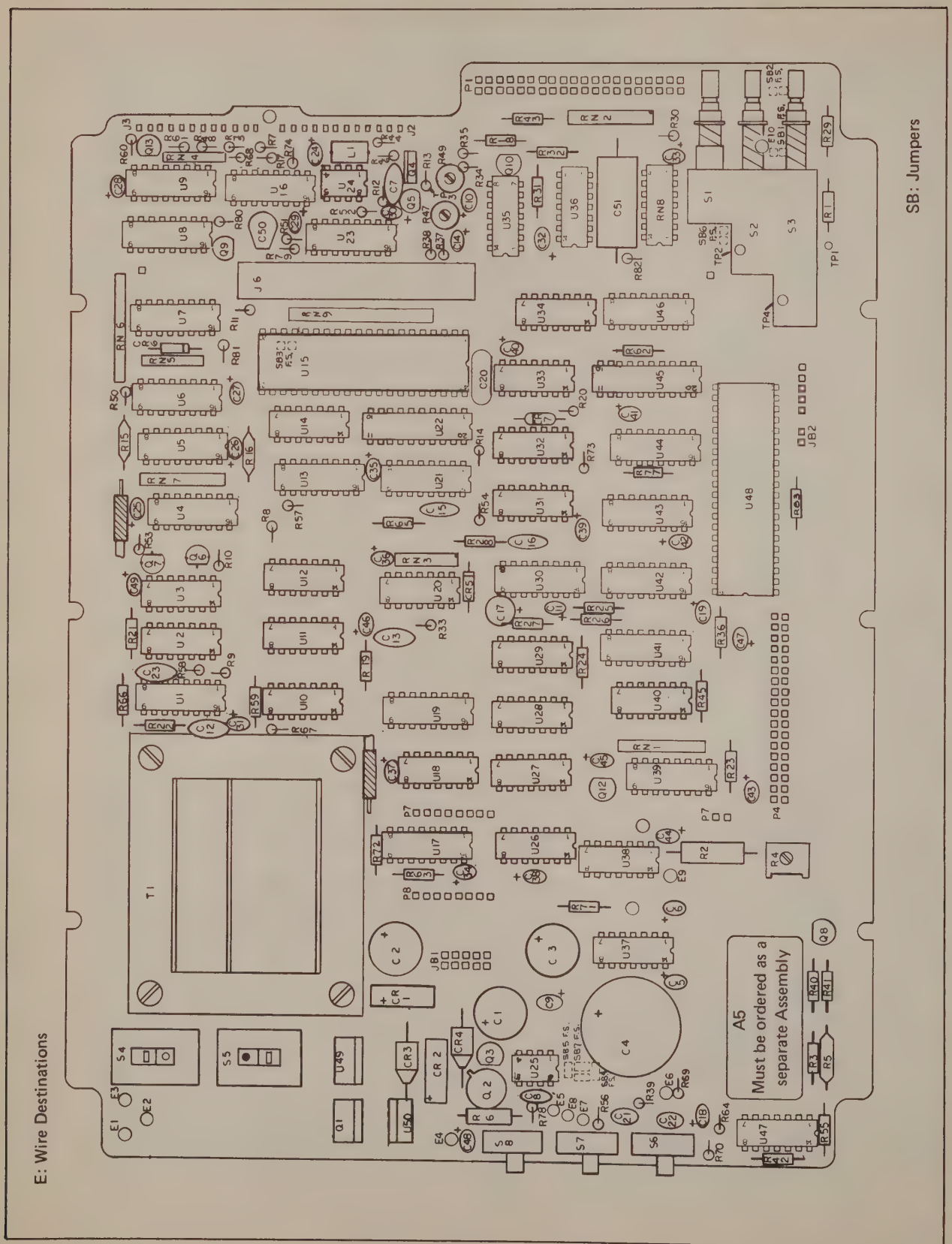


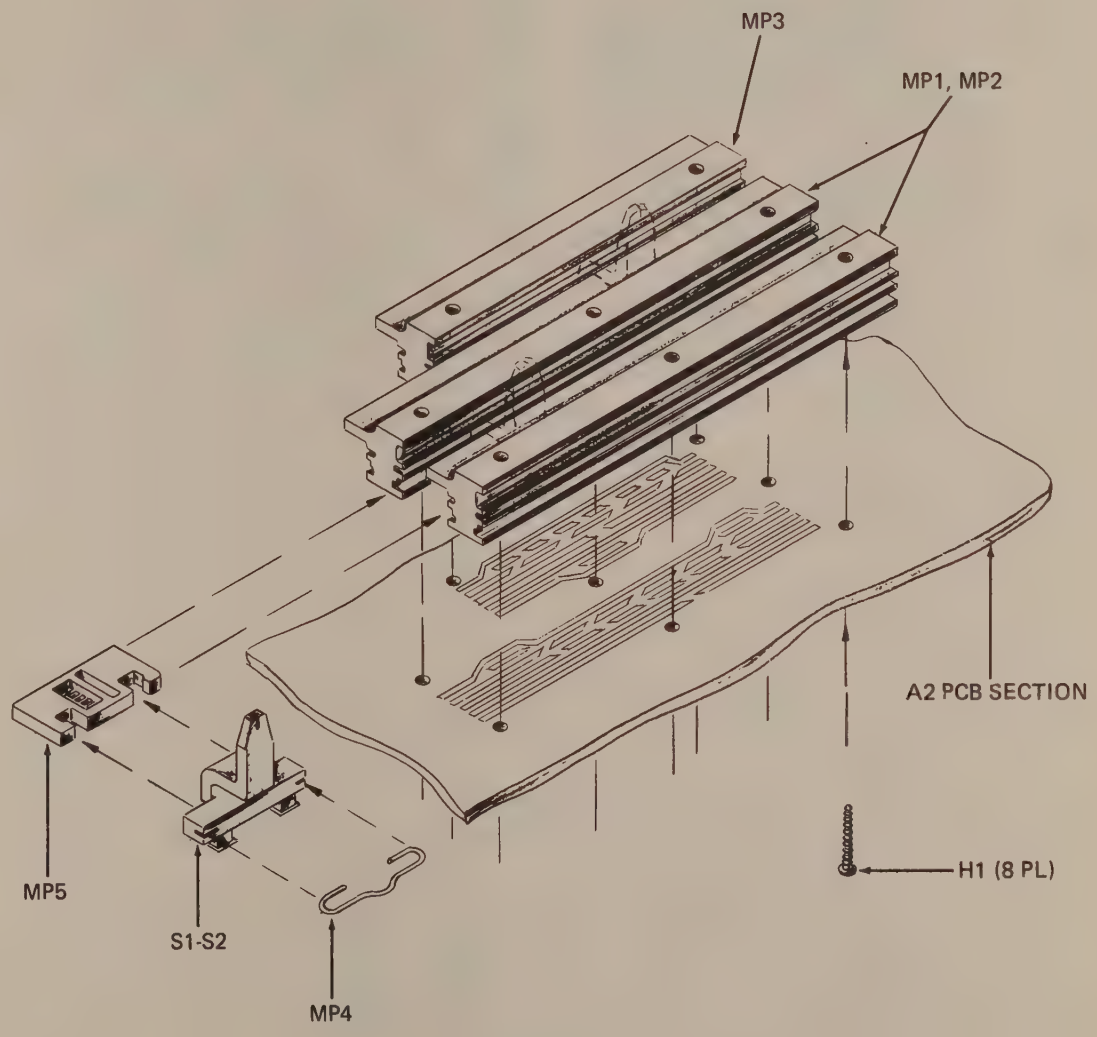
Figure 5-2. A1 Main PCB Assembly

Table 5-3. A2 Front Panel PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A2	FRONT PANEL PCB ASSEMBLY FIGURE 5-3 (7260A-4002T)	476028	89536	476028	REF		
C1	CAP, MTL, POLY, 0.68 UF +/-20%, 250V	478651	80031	C281A/AE68K	2		
C2	CAP, MTL, POLY, 0.68 UF +/-20%, 250V	478651	80031	C281A/AE68K	REF		
C3	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	4		
C4	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C5	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C6	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C7	CAP, CER, 33 PF +/-2%, 100V	354852	72982	8121-A100-C0G-330G	2		
C8	CAP, CER, 33 PF +/-2%, 100V	354852	72982	8121-A100-C0G-330G	REF		
CR1	DIODE, SI HI-SPEED SWITCHING	203323	07910	1N4448	2	1	
CR2	DIODE, SI HI-SPEED SWITCHING	203323	07910	1N4448	REF		
DS1	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	1	1	
DS2	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS3	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS4	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS5	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS6	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS7	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS8	DISPLAY, LED, RED, 7-SEGMENT	477562	89536	477562	REF		
DS9	DISPLAY, LED ARRAY STRIP	483420	28480	HLMP6203	1	1	
DS10	DISPLAY, LED ARRAY STRIP	483412	28480	HLMP6205	1	1	
DS11	DISPLAY, LED ARRAY STRIP	483412	28480	HLMP6205	REF		
DS12	DISPLAY, LED ARRAY STRIP	483412	28480	HLMP6205	REF		
DS13	DISPLAY, LED ARRAY STRIP	483412	28480	HLMP6205	REF		
DS14	DISPLAY, LED ARRAY STRIP	483412	28480	HLMP6205	REF		
DS15	DISPLAY, LED ARRAY STRIP	483420	28480	HLMP6203	REF		
DS16	DISPLAY, LED ARRAY STRIP	483420	28480	HLMP6203	REF		
DS17	DISPLAY, LED, RED	369777	28480	5082-4480	4	1	
DS18	DISPLAY, LED, RED	369777	28480	5082-4480	REF		
DS20	DISPLAY, LED, RED	369777	28480	5082-4480	REF		
DS21	DISPLAY, LED, RED	369777	28480	5082-4480	REF		
F2	FUSE, FAST ACTING	494930	75915	212.250	2	10	
F3	FUSE, FAST ACTING	494930	75915	212.250	REF		
H1	SCREW, PH, THD-FORMING, 2-28 X 13/32	493957	89536	493957	9		
J1	CONNECTOR, 40-PIN	460030	00779	5182-383-4	1		
J9	CONNECTOR, BNC, CHANNEL A	479162	55331	1067-000-801	2		
	SOCKET, IN-LINE, 10-PIN	477661	00779	583773-3	2		
J10	CONNECTOR, BNC, CHANNEL B	479162	55331	1067-000-801	REF		
	SOCKET, IN-LINE, 10-PIN	477661	00779	583773-3	REF		
J11	CONNECTOR, HORIZONTAL JACK, BLACK	149112	74970	105-0753	1		
MP1	CARRIER, 10-POS	477851	00779	435999-2	1		
MP2	CARRIER, 10-POS	477851	00779	435999-2	REF		
MP3	CARRIER, 7-POS	477737	00779	435999-1	1		
MP4	DETENT SPRING	472878	00779	435996	2		
MP5	WIPER GUIDE	472886	00779	435998	2		
MP6	SPACER, LED (DS9 THRU DS15)	426882	89536	426882	3		
MP7	SPACER, LED (TO DS17, 18, 20, 21)	471094	89536	471094	4		
R1	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	3		

Table 5-3. A2 Front Panel PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R2	RES, MTL. FILM, 402K +/-1%, 1/8W	217984	91637	CMF554023F	4		
R3	RES, MTL. FILM, 402K +/-1%, 1/8W	217984	91637	CMF554023F	REF		
R4	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R5	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R6	RES, COMP, 2K +/-5%, 1/2W	169854	01121	EB2025	4		
R7	RES, COMP, 2K +/-5%, 1/2W	169854	01121	EB2025	REF		
R8	RES, MTL. FILM, 402K +/-1%, 1/8W	217984	91637	CMF554023F	REF		
R9	RES, COMP, 2K +/-5%, 1/2W	169854	01121	EB2025	REF		
R10	RES, COMP, 2K +/-5%, 1/2W	169854	01121	EB2025	REF		
R11	RES, MTL. FILM, 402K +/-1%, 1/8W	217984	91637	CMF554023F	REF		
R12/S13	RES, VAR, CER, W/S, 1M +/-10%, 1/2W	478966	89536	478966	1	1	
R13/S9	RES, VAR, CER, W/S, 5K +/-10%, 1/2W	478974	89536	478974	2	1	
R14/S10	RES, VAR, CER, W/S, 5K +/-10%, 1/2W	478974	89536	478974	REF		
R15	RES, DEP. CAR, 24 +/-5%, 1/4W	442210	80031	CR251-4-5P25E	2		
R16	RES, DEP. CAR, 24 +/-5%, 1/4W	442210	80031	CR251-4-5P25E	REF		
S1	SWITCH, SLIDE, ACTUATOR	454371	00779	435995	2	1	
S2	SWITCH, SLIDE, ACTUATOR	454371	00779	435995	REF		
S3	SWITCH, SLIDE, 3-POS	453183	89536	453183	2	1	
S4	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	6	2	
S5	SWITCH, SLIDE, 3-POS	453183	89536	453183	REF		
S6	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	REF		
S7	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	REF		
S8	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	REF		
S9/R13	RES, VAR, CER, W/S, 5K +/-10%, 1/2W	478974	89536	478974	REF		
S10/R14	RES, VAR, CER, W/S, 5K +/-10%, 1/2W	478974	89536	478974	REF		
S11	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	REF		
S12	SWITCH, SLIDE, SPDT	429332	09353	1101-M2-C-Q	REF		
S13/R12	RES, VAR, CER, W/S, 1M +/-10%, 1/2W	478966	89536	478966	REF		
U1	IC, LINEAR, OP AMP	473777	89536	473777	1	1	



Sheet 1 of 2

Figure 5-3. A2 Front Panel PCB Assembly

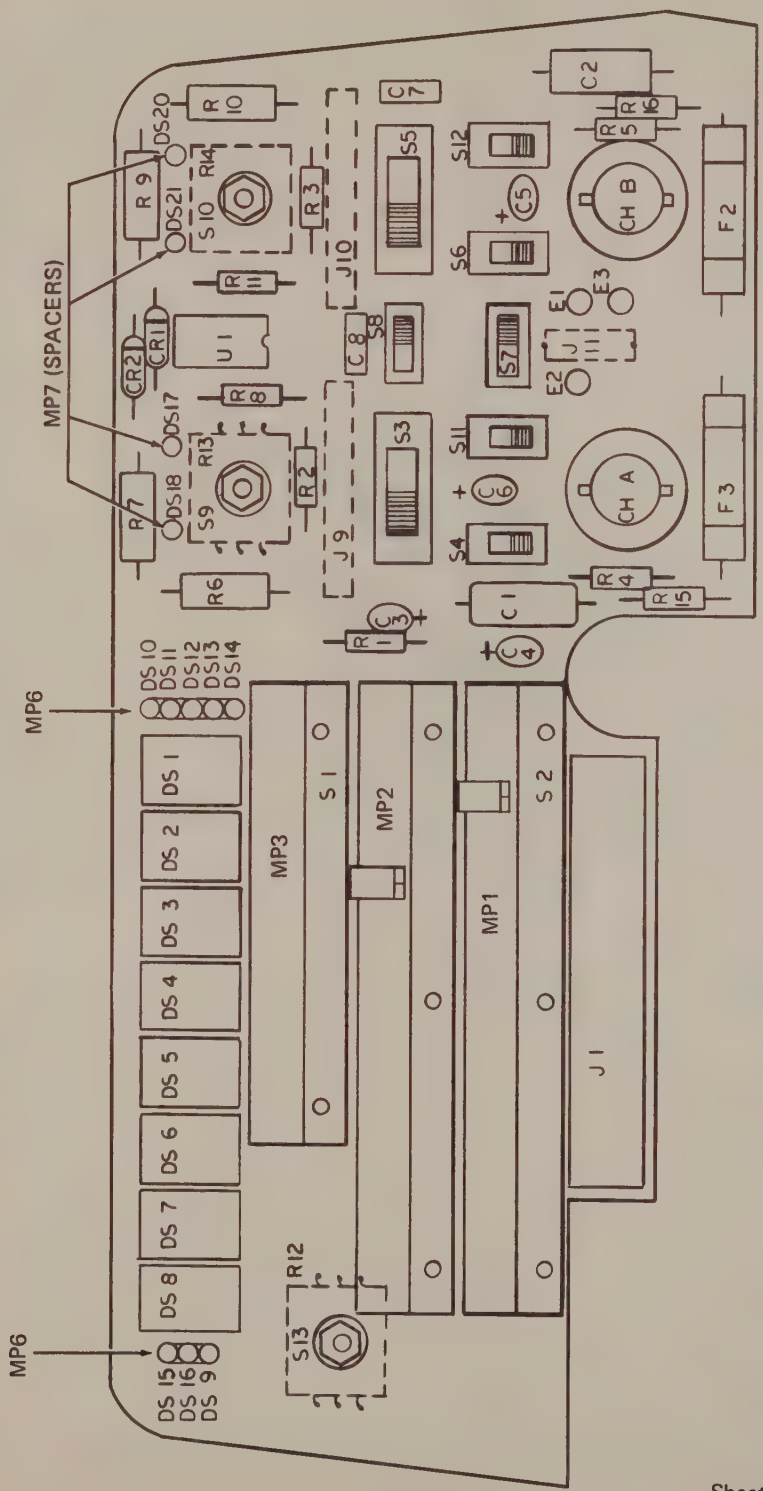


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Figure 5-3. A2 Front Panel PCB Assembly (cont)

Table 5-4. A5 Time Base PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A5	TIMEBASE PCB ASSEMBLY FIGURE 5-4 (7220A-4009T)	538660	89536	538660	REF		
C1	CAP, VAR, 1.5-15 PF, 250V	543520	91293	8091	1		
C2	CAP, CER, 22 PF +/-5%, 100V	448449	80031	2222-638-10229	1		
C3	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	1		
C4	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	1		
L1	CHOKE, 6-TURN	320911	89536	320911	1		
MP1	PINS, CONTACT	379438	00779	86144-5	5		
R1	RES, MTL. FILM, 47.5 +/-1%, 1/8W	306076	91637	CMF554752F	1		
R2	RES, COMP, 560 +/-10%, 1/8W	115303	89536	115303	5		
R3	RES, COMP, 1K +/-10%, 1/8W	153916	01121	BB1021	1		
R4	RES, COMP, 560 +/-10%, 1/8W	115303	89536	115303	REF		
R5	RES, COMP, 560 +/-10%, 1/8W	115303	89536	115303	REF		
R6	RES, COMP, 560 +/-10%, 1/8W	115303	89536	115303	REF		
R7	RES, COMP, 560 +/-10%, 1/8W	115303	89536	115303	REF		
U1	IC, ECL, DUAL 4-5 INPUT, OR/NOR GATE	454967	04713	MC10109P	1	1	
Y1	CRYSTAL, QUARTZ	385732	89536	385732	1		

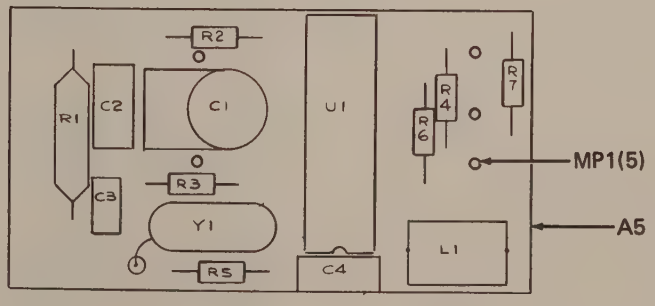

Figure 5-4. A5 Time Base PCB Assembly

Table 5-5. A6 10-100 MHz Multiplier PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A6	10-100 MHZ MULTIPLIER PCB ASSEMBLY FIGURE 5-5 (7261A-4003T)	475855	89536	475855	REF		
C1	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	4		
C2	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C3	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C4	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C5	CAP, TA 0.033 UF +/-10%, 250V	234492	80031	C280MAE/A33K	1		
C6	CAP, MICA, 330 PF +/-1%, 500V	226142	72136	DM15F331F	1		
C7	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	1		
C12	CAP, CER, 0.0012UF +/-10%, 500V	106732	71590	CF-122	3		
C13	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-0000-Y5U0-503Z	3		
C14	CAP, MICA, 120 PF +/-5%, 500V	148486	72136	DM15F121J	1		
C15	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-0000-Y5U0-503Z	REF		
C16	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-0000-Y5U0-503Z	REF		
C17	CAP, CER, 0.0012 UF +/-10%, 500V	106732	71590	CF-122	REF		
C18	CAP, MICA, 56 PF +/-1%, 500V	284810	72136	DM15F360F	1		
C19	CAP, VAR, 2-10 PF, 100V	460725	80031	CT5E2R510-A	1	1	
C20	CAP, CER, 0.0012 UF +/-10%, 500V	106732	71590	CF-122	REF		
C21	CAP, MICA 12 PF +/-5%, 500V	175224	72136	DM15F120J	1		
CR1	DIODE, TUNING	473827	91462	KV-2002	1	1	
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	1	1	
H1	SCREW, PHP, 4-40 X 1/4	129890	73734	19022	2		
H2	WASHER, INT/LK #4	110403	73734	1302	2		
J7	CONN, RECEPTACLE	375329	00779	85863-3	10		
L1	CHOKE, 6-TURN	320911	89536	320911	5		
L2	CHOKE, 6-TURN	320911	89536	320911	REF		
L3	CHOKE, 6-TURN	320911	89536	320911	REF		
L4	CHOKE, 6-TURN	320911	89536	320911	REF		
L5	CHOKE, RF	186288	72259	WEE390	1		
L6	CHOKE, 6-TURN	320911	89536	320911	REF		
MP1	COVER, STRIP-LINE	476895	89536	476895	1		
MP2	JACK, CONNECTOR	149112	74970	105-0753	1		
Q1	XSTR, SI, NPN	454231	89536	454231	1	1	
Q2	XSTR, SI, NPN	453688	01295	A5T3571	2	1	
Q3	XSTR, SI, NPN	453688	01295	A5T3571	REF		
Q4	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q5	XSTR, SI PNP	195974	04713	2N3906	3	1	
Q6	XSTR, SI, NPN	248351	04713	MPS918	2	1	
Q7	XSTR, SI, NPN	248351	04713	MPS918	REF		
Q8	XSTR, SI PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI PNP	195974	04713	2N3906	REF		
Q10	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, MTL. FILM, 866 +/-1%, 1/8W	284641	91637	CMF558660F	2		
R2	RES, MTL. FILM, 866 +/-1%, 1/8W	284641	91637	CMF558660F	REF		
R3	RES, MTL. FILM, 22.6K +/-1%, 1/8W	288431	91637	CMF552262F	1		
R4	RES, DEP. CAR, 560 +/-5%, 1/4W	385948	80031	CR251-4-5P560E	4		
R5	RES, MTL. FILM, 2.61K +/-1%, 1/8W	289983	91637	CMF552611F	1		
R6	RES, DEP. CAR, 560 +/-5%, 1/4W	385948	80031	CR251-4-5P560E	REF		
R7	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	2		

Table 5-5. A6 10-100 MHz Multiplier PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R8	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	2		
R9	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	REF		
R10	RES, DEP. CAR, 560 +/-5%, 1/4W	385948	80031	CR251-4-5P560E	REF		
R11	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	4		
R12	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R13	RES, DEP. CAR, 56 +/-5%, 1/4W	342618	80031	CR251-4-5P56E	3		
R14	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	2		
R15	RES, DEP. CAR, 56 +/-5%, 1/4W	342618	80031	CR251-4-5P56E	REF		
R16	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R17	RES, DEP. CAR, 2.2K +/-5%, 1/4W	343400	80031	CR251-4-5P2K2	1		
R18	RES, DEP. CAR, 56 +/-5%, 1/4W	342618	80031	CR251-4-5P56E	REF		
R19	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	1		
R20	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R21	RES, DEP. CAR, 27 +/-5%, 1/4W	348763	80031	CR251-4-5P27E	1		
R22	RES, DEP. CAR, 680 +/-5%, 1/4W	368779	80031	CR251-4-5P680E	1		
R23	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R24	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R25	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	1		
R26	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R27	RES, DEP. CAR, 560 +/-5%, 1/4W	385948	80031	CR251-4-5P560E	REF		
R28	RES, COMP, 110 +/-5%, 1/8W	500983	01121	BB1115	1		
U1	IC, ECL, 10,000 SERIES, BI-QUINARY CNTR	454942	04713	MC10138P	1		1
U2	IC, ECL, PHASE FREQUENCY DETECTOR	429670	04713	MC12040P	1		1

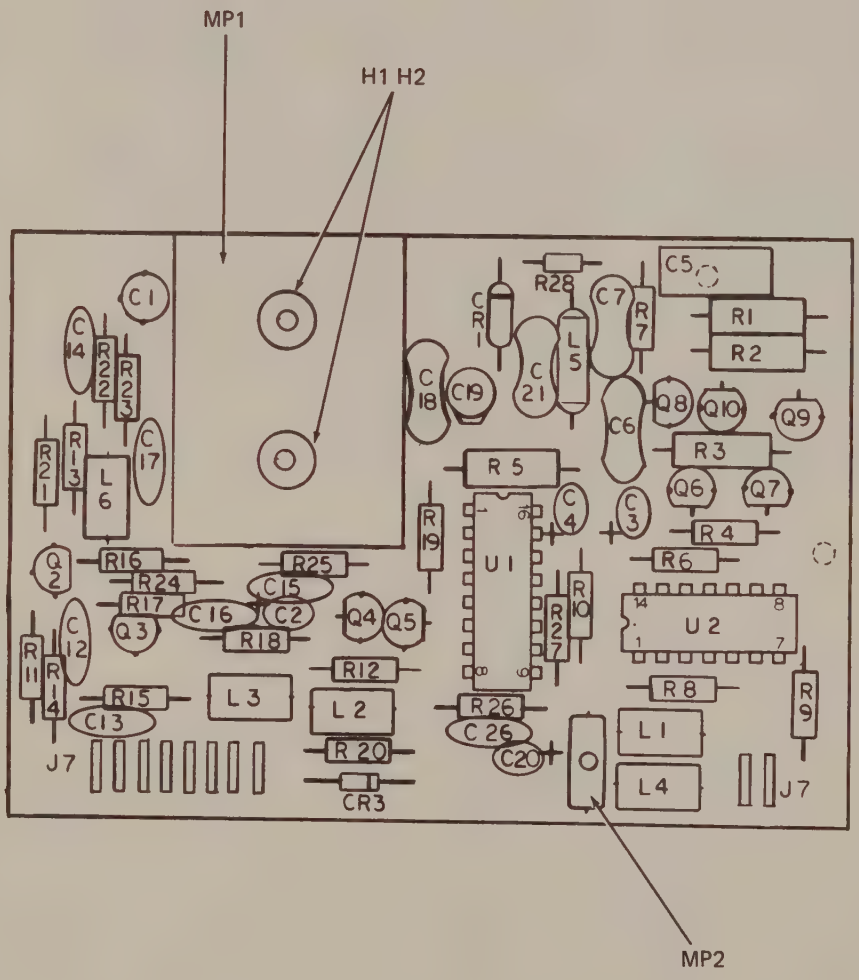

Figure 5-5. A6 10-100 MHz Multiplier PCB Assembly

Section 6
Option & Accessory Information

TABLE OF CONTENTS

OPTION/ MODEL NO.	DESCRIPTION	PAGE
	ACCESSORIES	600-1
	OPTIONS	
72XXA-010	Battery Pack	010-1
72XXA-112	2 PPM TCXO	6112-1
72XXA-131	Low Power Oven Time Base	131-1
72XXA-132	Superior Low Power Oven Time Base	132-1
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72XXA-310	520 MHz Direct	6310-1
72XXA-331	1300 MHz Prescaler	6331-1
72XXA-521	Data Input/Output Unit	521-1

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the options and accessories available for the 7261A. Where applicable, these descriptions will cover the same range of information as provided in Sections 1-5 of this manual (specifications, installation, theory of operation, etc.). Schematic diagrams for any appropriate option or accessory will be found in Section 3.

6-3. Accessory information can be identified with "600-" paragraph numbers. For options, relevant paragraphs will contain the option number preceded by "6".

Accessories

600-1. GENERAL

600-2. The Table of Contents contains a list of accessories available for use with the 7261A Universal Counter/Timer. The following paragraphs contain descriptions for each type of accessory. Use the accessory model number when ordering.

600-3. Mounting Kits

600-4. Mounting kits suited for the C-size case used with the 7261A are available for standard 19-inch rack or panel format. Each kit comes complete with all mounting hardware. Model Y2014A provides for mounting a single case (size "C") in a 19-inch rack. Model Y2015 mounts two cases ("C") in a 19-inch rack. Model Y2020 mounts a single "C" case in a panel arrangement.

600-5. Instrument Cables

600-6. Two instrument ribbon cables are available for connecting the Data I/O Unit (Option -521) to the Interface PCB Assembly (Option -522), mounted in the 1120A IEEE-488 Translator. The cables, while identical in function, are available in lengths of two feet (Y7203) or five feet (Y7204). The Y7203 cable is supplied with Options -521 or -529 and Option Kits -521K or -529K.

600-7. Filter/Attenuator

600-8. The Model Y7201, as shown in Figure 600-1 is a combination variable attenuator and selectable low-pass filter intended for use as an input signal noise suppressor for Fluke counters. It features a continuously variable X5 to X100 attenuator and a set of three switch-selectable frequency filters; DC to 1 kHz, DC to 20 kHz, or DC to 100 kHz. The Y7201 allows a maximum input signal of 230V ac at 50 Hz for 30 seconds. A BNC connector is provided for convenient attachment to the counter input, and a set of 0.75" spaced banana jacks serve as the input signal connections.

600-9. In operation, the Y7201 attenuates and/or filters unwanted noise/transients from the input signal. These capabilities isolate the counter from the noise levels and, thereby, lessen the possibility of measurement errors.

600-10. To operate the Y7201, use the following procedure:

1. Connect the Y7201 to the CHANNEL A (or CHANNEL B) input to the counter.

2. Select the filter position with the lowest 3 dB point (1 kHz, 20 kHz or 100 kHz) that will accomodate the signal being measured.

3. Turn the ATTEN control fully clockwise (for maximum attenuation).

4. Connect the signal to be measured to the Y7201's banana jacks.

5. Decrease attenuation until a stable display is seen on the counter.

NOTE

For signals that are particularly noisy (or greater than 100V p-p), it may be necessary to add more attenuation and filtering. This operation can be accomplished by adding another Y7201 in series or by adjusting the counter's attenuation and filter controls.

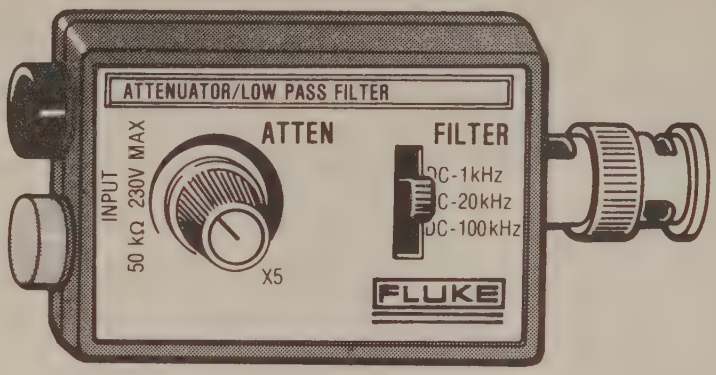


Figure 600-1. Y7201 Filter/Attenuator

Option -010
Battery Pack

010-1. INTRODUCTION

010-2. Option -010 is a nickel-cadmium rechargeable battery unit. The option uses "F" cell nicad batteries for a total capacity of 5.6 amp hours. With a completely discharged battery, charge time is a minimum of 16 hours at room temperature. A discharge cut-off relay has been incorporated to guard against discharging the nicads to too low a level. A thermistor sensor circuit monitors battery temperature and halts the charging if the battery gets too hot. The battery output is fused to protect it against short circuits. Housed in a separate plastic box to eliminate acid corrosion problems, the battery assembly is attached inside the top cover. This option can be installed in the field. Order kit number 72XXA-010K.

010-3. SPECIFICATIONS

010-4. Specifications for the -010 Battery Option are listed in Table 010-1.

010-5. INSTALLATION

010-6. Use the following procedure to install the -010 Battery Option. Refer to Figure 010-1 for installation instructions. Component location can also be determined using Figures 010-3 and 010-4.

1. Remove line power from the instrument.

2. Remove the top cover using the procedure described in Section 4.

3. Place the battery assembly so that the battery and Battery Option PCB are closer to the front of the instrument and the two instrument handle hold-down bolts are through the corresponding holes on the battery bracket.

4. Place the two nuts on the instrument handle hold-down bolts and tighten.

5. Remove the bottom cover using the procedure described in Section 4. Do not remove the Front or Rear Panel assemblies from the Main PCB.

6. Locate solder bridge SB1 near the BTRY/LINE switch on the bottom of the Main PCB. (For 7220A, SB1 is on the front left corner of the bottom of the main PCB). Remove the short. In addition, remove the short on SB6 for the 7261A only.

7. Install the bottom cover.

8. Plug the two cables from the Battery Option PCB into their appropriate connectors on the Main PCB. Grey plug to JB1, black plug to JB2.

9. Fasten the grey ribbon cable under the grey retaining clip (located on the bottom side of the instrument's top cover).

10. Install the top cover of the instrument.

Table 010-1. Specifications

Capacity	5.6 Ampere hours
Battery Type	Four size "F" nicad cells
Charge Time	16 hours minimum at room temperature
Charge Protection	Thermistor actuated shut down of charging circuit if battery gets near 65°C
Discharge Protection	Low voltage automatic shut down at about +4V to prevent battery discharging to a reversed cell condition.

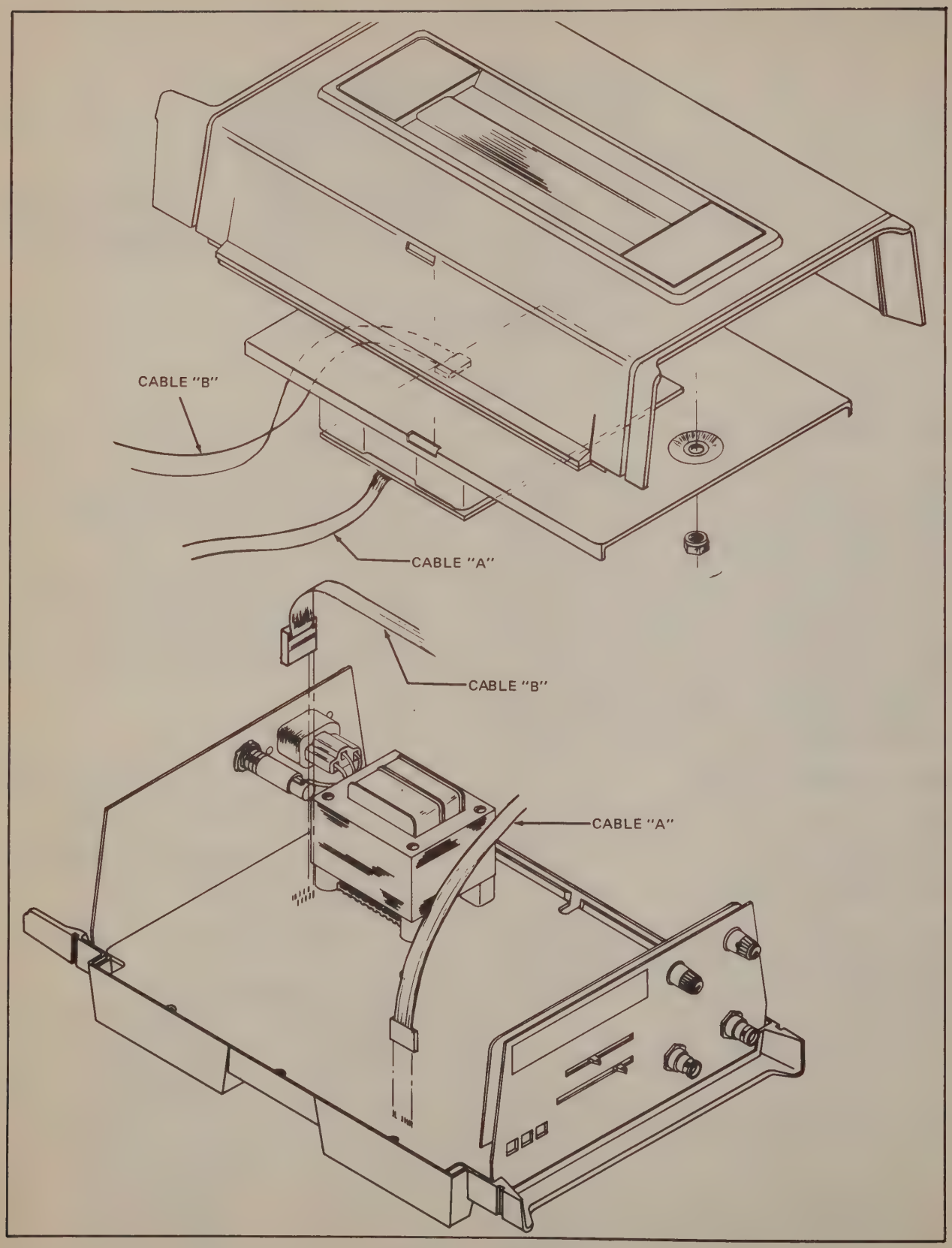


Figure 010-1. Installation

010-7. OPERATION

010-8. To use the battery for instrument power, set the BTRY/LINE switch to the BTRY position. The ON/STBY switch functions normally. The instrument may be powered from the battery with the line cord plugged into line power. This serves no useful purpose, however, and discharges the battery needlessly. When the battery has discharged to about 4V, the low battery voltage relay will remove the instrument load from the battery output, preventing the battery from discharging to too low a level. Place the two POWER switches in the STBY and LINE positions to recharge the battery. After the battery has been charged sufficiently, the RESET switch on the instrument front panel must be pressed to unlatch the low voltage relay and restore normal battery operation.

010-9. If neither oven time base option is installed, the battery will recharge any time the instrument is connected to line power and the power control is set to STBY. The charge rate is maximum when the ON/STBY switch is in the STBY position, and the BTRY/LINE switch is in the LINE position. If the battery is discharged completely, this charge rate will recharge the battery in 16 hours at temperatures around 22°C (72°F). If either oven time base is installed, the BTRY/LINE switch determines which source will power the oven. For maximum charge, the switch must be in the LINE position and the ON/STBY switch must be in the STBY position. If the BTRY/LINE switch is in the BTRY position and the ON/STBY switch is in the STBY position, the oven will draw about 200 mA of the 560 mA charging current. Under these conditions, the battery may not charge completely. If the POWER switches are in the ON and LINE positions, the charging rate will be reduced to prevent overheating inside the instrument. This charge rate is insufficient to recharge the battery but will maintain a float charge on the battery. The thermocouple sensor will halt the charge to keep the battery temperature from exceeding 65°C (149°F). (This will only occur in high ambient temperature environments.) The battery charge will automatically resume when the battery has cooled enough.

NOTE

Battery manufacturers recommend that nicad batteries should not be stored for extended periods of time without recharging at least every 90 days. Storage temperature below 25° C (77° F) is recommended.

010-10. THEORY OF OPERATION

010-11. The theory of operation for the -010 Option will be divided into a basic functional description of the major circuits of the option and a detailed circuit analysis of each circuit.

010-12. BASIC FUNCTIONAL DESCRIPTION

010-13. As Figure 010-2 shows, there are four main sections to the Battery Option PCB circuitry. The Current Source uses +5V unregulated power from the Main PCB to provide the charging current for the battery. The charging rate (high or low) is determined by the position of the ON/STBY switch. The Battery Hi-Temp Circuit reduces the charging current if the battery temperature approaches 65°C. The Low Battery Voltage Relay circuit normally passes the battery power on to the BTRY/LINE switch. Should the battery voltage drop to around 4V, the relay contacts will open, removing the load from the battery. The RESET switch on the instrument front panel must be pressed to restore the Low Battery Voltage Relay Circuit. If the BTRY/LINE switch is in the BTRY position, the +5V power from the battery is connected to the ON/STBY switch, and the oven if an oven time base is installed. If the ON/STBY switch is in the ON position, the battery power is supplied to the instrument and the Inverter circuit. The Inverter circuit provides operating voltages for the -5V, +12V and -12V regulators.

010-14. DETAILED CIRCUIT ANALYSIS

010-15. The Battery Option Schematic in Section 8 will be used to illustrate the detailed circuit analysis. The battery and thermistor are located inside the battery case.

010-16. Battery Hi-Temp Circuit

010-17. The Battery Hi-Temp Circuit is an inverting amplifier that protects the battery by reducing the battery charging current as the battery temperature approaches 65°C. It does this by altering the bias voltage of the Current Source controller to turn off the current source. The inverting amplifier is U1B with thermistor RT1 used as the feedback resistor. The positive input of the op amp is COMMON. The negative input is the -12V coupled through R9. RT1 is located next to the battery. When the battery is about 22°C, the resistance of RT1 will be about 50Ω. At this time, the output of the inverting amplifier (felt at the lower junction of R7 and R8) is about +.4V. RT1 exhibits a positive temperature coefficient. As the battery temperature rises, the resistance of RT1 increases. When the battery temperature approaches 65°C, the resistance of RT1 passes over a sharp knee and approaches 500Ω. The output of the negative gain amplifier approaches +5V.

010-18. Current Source

010-19. The Current Source uses the unregulated +5V from the Main PCB to provide charging current for the

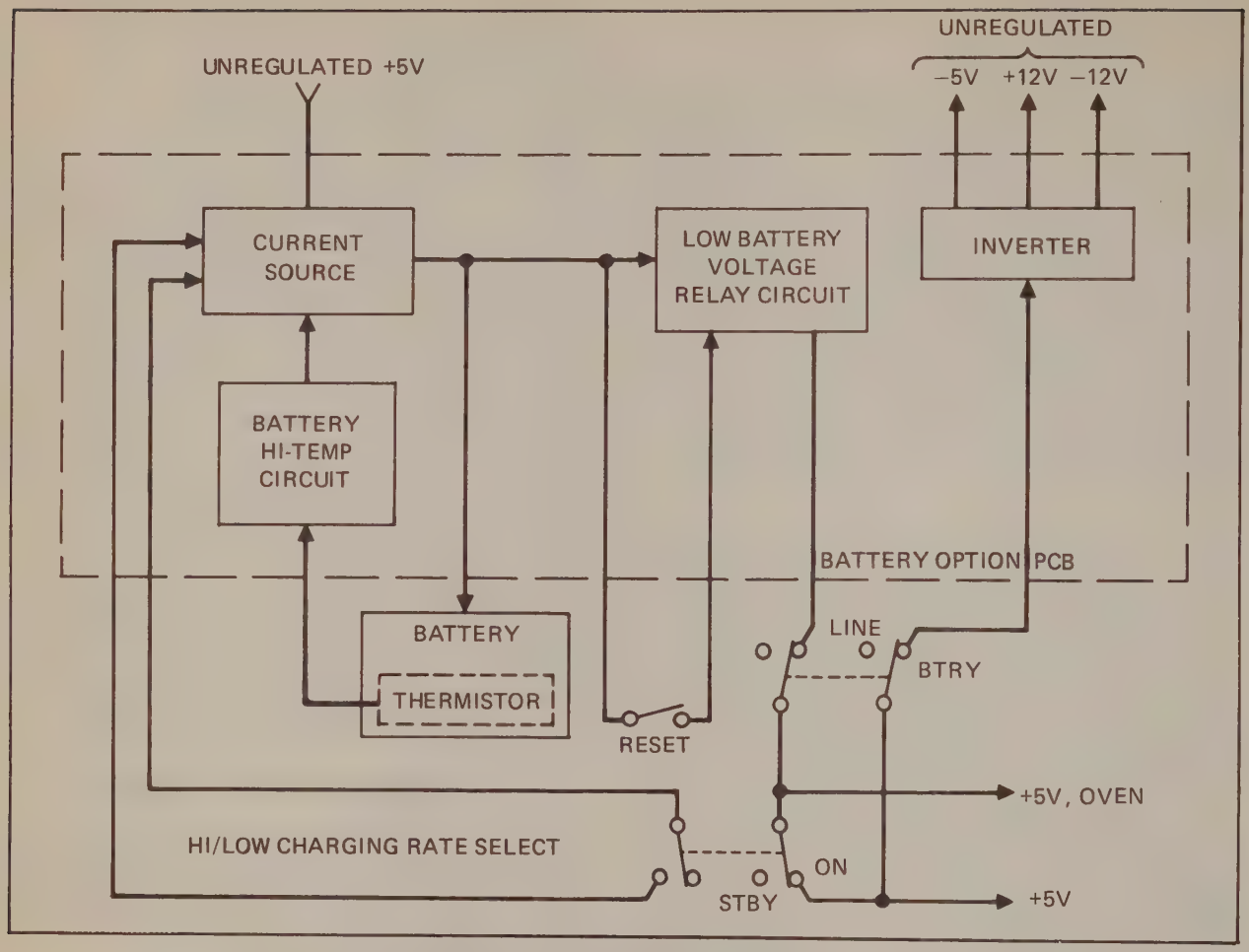


Figure 010-2. -010 Option Block Diagram

battery. This circuit consists of the series pass element, Q1; the sensing element, R1; the control element, U1A; and their associated circuitry. Q1 directly controls the current charging the battery. The base bias of Q1 is in turn controlled by the output of U1A. The positive input is battery voltage felt on the battery side of R1 (TP2). The negative input is picked off the voltage divider network composed of R2, R8 and sometimes R7. The voltage divider is between the input side of R1 (TP1) and the output of the Battery Hi-Temp circuit.

010-20. The charging current is changed by altering the input to U1A from the voltage divider. The voltage divided input is altered by changing the position of the ON/STBY switch. When the switch is in the STBY position, R7 is placed in parallel with R8. Their combined resistance is about one-fifth that of R8 alone. At normal operating temperatures, the bottom of the voltage divider is at +0.5V and the top is at battery voltage plus the voltage drop across R1. The op amp causes Q1 to pass nominally 560 mA through R1. If the ON/STBY switch is in the ON position, R7 is no longer in parallel with R8. This change in the voltage divider input to U1A will cause the charging current to decrease to nominally 110 mA. If the battery temperature approaches 65° C, the bottom of the voltage divider becomes +5V and the voltage at TP1 approaches the battery voltage. This decreases the output of the op amp cutting off Q1. As the battery cools, the resistance of the thermistor decreases allowing the battery charge to resume. If F1 blows, removing the regulated input to U1A, CR10 will limit the conduction of Q1 so that the voltage at TP2 does not exceed 6V.

010-21. Low Battery Voltage Relay Circuit

010-22. The low battery voltage relay keeps the battery from discharging to a reversed cell condition by removing the battery load when battery voltage drops to about 4V. The battery is connected to its load through K1, a two coil latching relay. During normal operation, the battery and its load are connected, Q2 and Q6 are off and Q5 is in saturation. When battery voltage drops to about 4V, the base bias on Q5 (TP5) is low enough to cut Q5 off. This lets the input on pin 13 of flip-flop U2 rise. This will

change the state of U2 making the output on pin 11 of U2 go low. This causes Q6 to conduct, charging C2 and turning Q2 on. When Q2 conducts, the coil of K1 in the collector of Q2 will energize, opening K1. When K1 removes the battery loads, the input circuitry for Q2 is deenergized. C2 has been charged to make Q2 conduct long enough to insure that K1 is latched in the open condition. After the battery has been recharged, pressing the RESET switch on the front panel will connect battery voltage to both the reset coil of K1 and pin 6 of U2. The RESET switch contacts will be closed long enough to insure that K1 will be latched shut. This will restore the connection between the battery and its load. Q5 will go into saturation. The battery voltage at pin 6 of U2 will cause pin 11 to go high, turning off Q6.

010-23. Inverter

010-24. The Inverter is composed of Q3, Q4, T1 and their associated circuitry. The three components form an oscillator that runs at about 10 kHz. This oscillation allows T1 to step up the battery voltage to provide rectified operating voltages to the –5V, +12V and –12V regulators for instrument power.

010-25. PERFORMANCE TEST

010-26. Use the following procedure as a performance test. Table 010-2 lists the test points. The component location diagram at the end of this option can be used to locate these test points. The instrument will be referred to as the UUT (Unit Under Test). Use a variable DC power supply with an output range of at least 3-5V and the test equipment listed in Section 4.

1. Remove the top cover of the UUT using the procedure given in Section 4. Leave the cables from the Battery Option PCB connected to the Main PCB and lay the top cover beside the instrument, upside-down. The grey ribbon cable will have to be removed from the retaining clip on the bottom side of the top cover.

Table 010-2. Test Points

TEST POINTS	COMMENTS
TP1, TP2	Voltage across sensing resistor, R1.
TP3	COMMON
TP4	Battery voltage.
TP5	Low Battery Voltage Sensing Point
TP6	Low Battery Voltage Cut-Off Signal.

2. Connect the UUT to line power.

3. On the UUT front panel:

   a. Set the ON/STBY switch to the STBY position.

   b. Set the BTRY/LINE switch to the LINE position.

4. Connect the DVM: + to TP2, – to TP3.

5. Verify that the DVM reads greater than 5V. If it does not, continue the charge until this reading (Battery Voltage) is at least 5V.

NOTE

In the next step, the DVM test leads must be isolated from ground.

6. Connect the DVM: + to TP1, – to TP2.

7. Verify that the DVM reads between 96 mV and 128 mV.

8. Set the ON/STBY switch to ON.

9. Verify that the DVM reads between 14 mV and 30 mV.

10. Set the ON/STBY switch to STBY.

11. Connect the DVM: + to TP4, – to TP3.

12. Verify that the DVM reads battery voltage. If there is no voltage present, press the RESET switch on the front panel. The DVM should now read battery voltage.

CAUTION

Counter must be disconnected from ground during the following soldering procedures. Disconnect the power cord and any other connection (e.g., BNC) that may be introducing a ground to the instrument.

13. Unsolder an end of the fuse wire located on the PCB near the battery harness.

14. Adjust the DC Power Supply for a +5V output.

15. Connect the DC Power Supply + to TP2, – to TP3.

16. Connect the DVM + lead to TP4, – lead to ground.

17. Slowly reduce the DC Power Supply voltage until the relay opens as indicated by the voltage of TP4 dropping suddenly to 0V. (The click of the relay may also be heard.)

18. Verify that the output voltage of the DC Power Supply is between +3.8V and +4.3V.

19. Disconnect the DC Power Supply. Resolder the fuse wire.

20. On the front panel of the UUT:

a. Press and release the RESET switch.

b. Set the ON/STBY switch to the ON position.

c. Set BTRY/LINE switch to the BTRY position.

d. Set the RESOLUTION switch to the 1 kHz position. (For 7220A, 100 Hz.)

e. Set the function select switch to the CHK position.

21. Verify that the UUT display reads 10.000. (For 7220A, display should read 10.0000.)

010-27. MAINTENANCE

010-28. Battery Replacement

010-29. Use the following procedure to replace the battery:

1. Remove the line power from the instrument.

2. Remove the top cover of the instrument using the procedure given in Section 4. Place the top cover upside-down on the work surface.

3. Disconnect the two cables between the Battery PCB and the Main PCB.

4. Remove the four screws holding the battery case to the battery bracket.

5. Note the position of the thermistor. This will be important in a later step.

6. Lift the battery case and Battery Option PCB off the battery and place it to one side.

7. Unsolder the two wires connected to the battery (white and black).

8. Dispose of the old battery.

9. Solder the white and black wires to the tabs on the new battery. White to the tab on the recessed battery end (+) and black to the tab on the flush battery end (–).

10. Replace the battery case being sure to place the thermistor in the same position noted in step 5.

11. Connect the two cables between the Battery PCB and the Main PCB.

12. Replace the top cover.

010-30. Fuse Replacement

010-31. Use the following procedure to replace the fuse on the Battery Option PCB:

1. Remove the line power from the instrument.

2. Remove the top cover from the instrument using the procedure given in Section 4. Place the top cover upside-down on the work surface.

3. Unsolder the ends of F1 from its terminals.

4. Solder a suitable length of #35 magnet wire between the fuse terminals.

5. Place the top cover on the instrument.

010-32. LIST OF REPLACEABLE PARTS

010-33. Table 010-3 is a list of replaceable parts for the battery assembly. Figure 010-3 is the component location diagram for this table.

Table 010-3. Battery Option -010 Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
	⊗ BATTERY OPTION-010 ASSEMBLY FIGURE 6010-3 (7220A-4010T)	OPTION	-010		1		
	BATTERY PCB ASSY	ORDER	BY	OPTION -010	REF		
BT1	BATTERY ASSY	484048	89536	484048	1		
C1	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	6		
C2	CAP, TA, 4.7 UF +/-20%, 25V	161943	56289	196D475X0025KA1	1		
C3	CAP, TA, 330 UF, +/-10%, 6V	193011	56289	150D337X9006S	1		
C4	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C5	CAP, CER, 47 PF +/-20%, 1000V	369132	56289	C030B102H470J	1		
C6	CAP, CER, 0.1 UF +/-GVM, 25V	369199	71590	UK-25-104	1		
C7	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C8	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C9	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C10	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
CR1	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	9	2	
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR10	DIODE, ZENER, 7.5V	256446	07910	1N755B	1		
H1	NUT, HEX, #4	147611	89536	147611	2		
H2	SCREW, PHP, 4-40 X 1/4	129890	73734	19022	1		
H3	SCREW, PHP, 6-32 X 1/4	152140	73734	19042	8		
H4	SCREW, RHD, PH, 4-40 X 3/8	152124	73734	18024	2		
H5	SPACER	500074	89536	500074	4		
H6	WASHER, FLAT #8	110288	73734	97425	4		
H7	WASHER, FIBER	246488	73734	1471	4		
H8	WASHER, #6	110338	89536	110338	8		
H9	WASHER, #6	152140	89536	152140	4		
H10	WASHER, LOCK #4	110403	73734	1302	2		
H11	WASHER, SHOULDER, INSULATING	485417	86928	5607-50	1		
H12	WASHER, SPLIT #4	110395	89536	110395	1		
K1	RELAY, LATCHING	484535	89536	484535	1		
L1	CHOKE	502138	89536	502138	1		
MP1	BRACKET, BATTERY	476200	89536	476200	1		
MP2	CASE, BATTERY	475459	89536	475459	1		
MP3	CABLE TIE	172080	06383	SST-1M	1		
MP4	INSULATOR, REG.	412809	13103	43-77-8	1		
MP5	PLUG, CONNECTOR KEY (NOT SHOWN)	500801	52152	3435-0000	1		
MP6	SPACER, PCB COMPONENT (NOT SHOWN)	296319	89536	296319	1		
MP7	SPACER, XSTR (TO Q2) (NOT SHOWN)	152207	07047	10123-DAP	1		
Q1	TRANSISTOR, SI, NPN, PWR	325761	09214	D44C5	1	1	
Q2	XSTR, SI, NPN	346916	89536	346916	1	1	
Q3	XSTR, SI, NPN, PWR	325720	04713	MJE3055	2	1	
Q4	XSTR, SI, NPN, PWR	325720	04713	MJE3055	REF		

Table 010-3. Battery Option -010 Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
Q5	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q6	XSTR, SI, PNP	195974	04713	2N3906	1	1	
R1	RES, WW, 0.2 +/-3%, 0.7W	255661	89536	255661	1		
R2	RES, MTL. FILM, 1.1K +/-1%, 1/8W	241497	91637	CMF551101F	1		
R4	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
R5	RES, MTL. FILM, 86.6K +/-1%, 1/8W	291468	91637	CMF558661F	1		
R6	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	2		
R7	RES, MTL. FILM, 61.9K +/-1%, 1/8W	237230	91637	CMF556191F	1		
R8	RES, MTL. FILM, 249K +/-1%, 1/8W	268805	91637	CMF552493F	1		
R9	RES, DEP. CAR, 1.2K +/-5%, 1/4W	441378	80031	CR251-4-5P1K2	1		
R10	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	REF		
R11	RES, COMP, 10 +/-5%, 1W	166298	01121	GB1005	1		
R12	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	1		
R13	RES, DEP. CAR, 82 +/-5%, 1/4W	442277	80031	CR251-4-5P82E	1		
R14	RES, MTL. FILM, 10K +/-1%, 1/8W	168260	91637	CMF551002F	1		
R15	RES, MTL. FILM, 6.65K +/-1%, 1/8W	294918	91637	CMF556651F	1		
R16	RES, THERMISTOR, 10K +/-10%, 3 MW	104596	15801	JA41J1			
R17	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R18	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	1		
T1	XFMR, POWER	486530	89536	486530	1		
U1	IC, LINEAR OP AMP	414284	12040	LM1458N	1	1	
U2Ⓢ	IC, COS/MOS, NOR GATES, POS LOGIC	355172	02735	CD4001AE	1	1	
W1	CABLE, BATTERY #1	488403	89536	488403	1		
W2	CABLE, BATTERY #2	488411	89536	488411	1		
W3	CABLE, BATTERY #3	491704	89536	491704	1		

NOTE: Ⓢ **Indicates the item can be damaged by static discharge.**

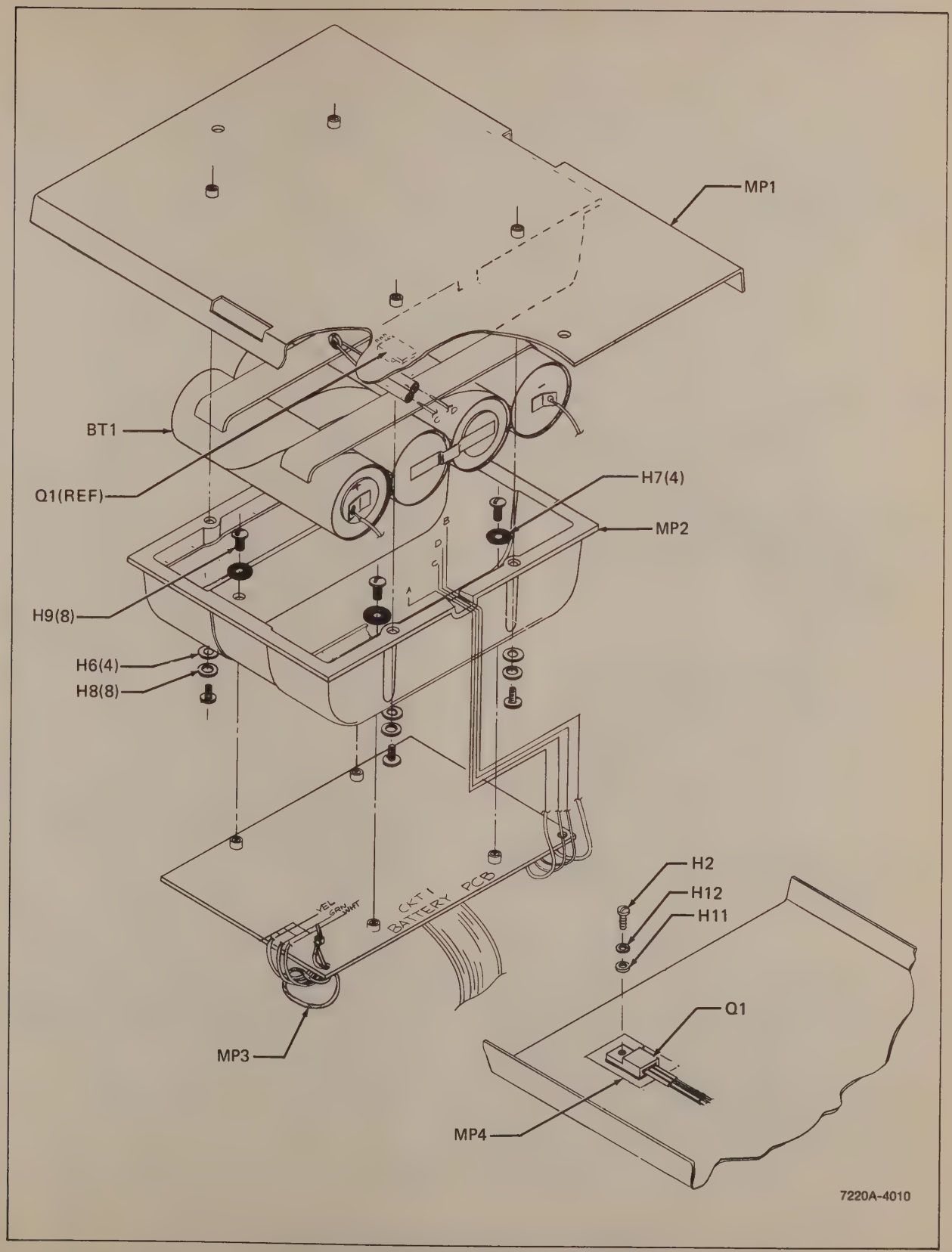


Figure 010-3. Battery Option -010 Assembly

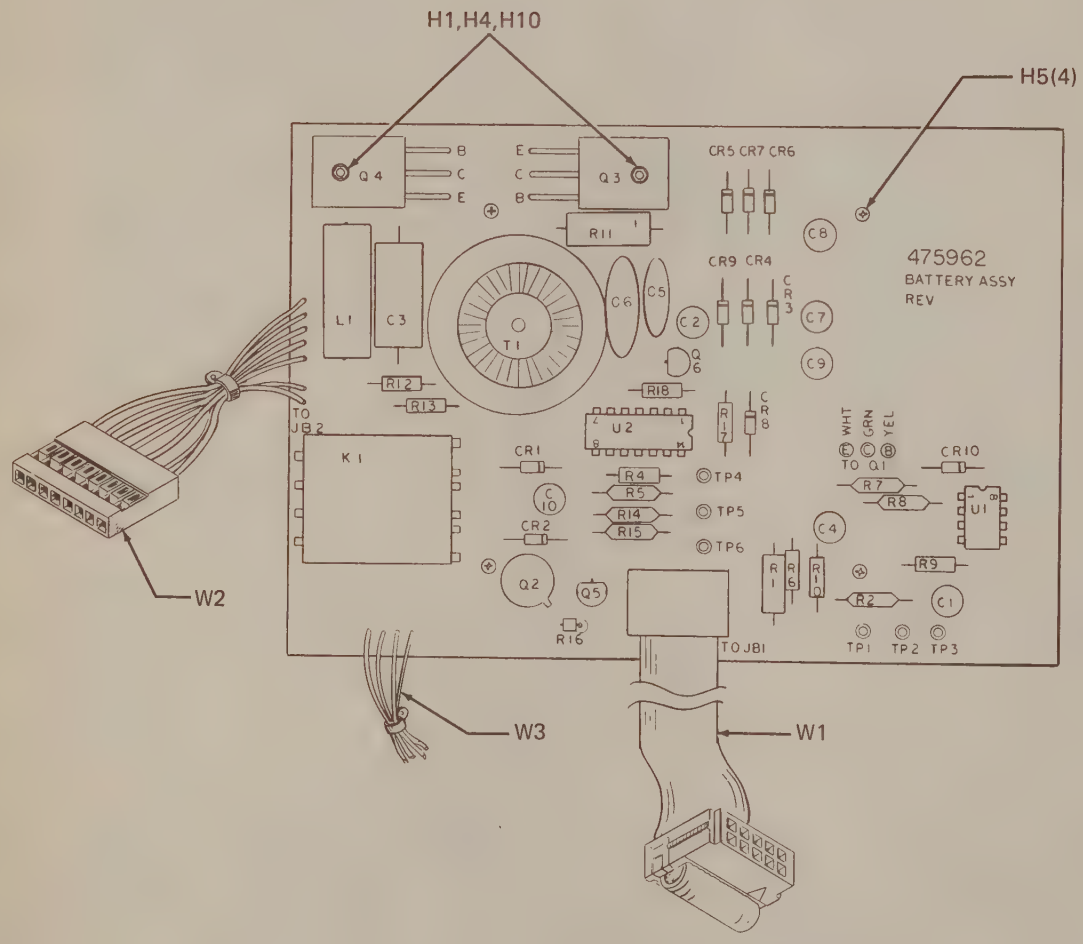


Figure 010-3. Battery Option -010 Assembly (cont)

Option-112
2 PPM TCXO

6112-1. INTRODUCTION

6112-2. Option -112 is a temperature compensated crystal oscillator (TCXO) with an intrinsic stability greater than the standard time base. This increased stability is due to a temperature compensation network. Figure 6112-1 shows the frequency variation for change in temperature for an uncompensated oscillator and the compensation network effect. The resulting frequency deviation (solid line) is held to a minimum over the designated temperature range. If the temperature limits are exceeded, the time base stability may exceed the specified value.

6112-3. SPECIFICATIONS

6112-4. Specifications of the 72XXA-112 Option are listed in Table 6112-1. Comparative specifications for the other time bases available are listed in Section 1.

6112-5. INSTALLATION

6112-6. Installation of the 2 PPM TCXO (Option -112) necessitates removal of the counter's Main PCB; refer to disassembly instructions in Section 4. For each counter, the TCXO is installed in the left rear corner of the Main PCB. Use the following installation procedure:

1. Unsolder and remove any other time base already installed.

2. Referring to Figure 6112-2, install the TCXO and the insulator.

3. While exercising care not to overheat the Main PCB, solder the TCXO connections.

4. Complete jumper and solder bridge arrangements as described below:

a. 7250A: Ensure that solder bridge SB2 is not shorted (bottom of Main PCB, left front corner). Also remove any jumper between W1 and +5V, and jumper W1 to +12V (top of Main PCB, left front corner).

b. 7260A or 7261A: If necessary, remove the shorts on solder briges SB2 (bottom of Main PCB, left front corner) and SB4 (bottom, left rear). Jumper SB5 (left rear, next to SB4) to the immediately adjacent side of SB4.

6112-7. OPERATION

6112-8. Operation of the instrument with the -112 Option installed is the same as operation of a standard instrument. Refer to Section 2 for operating instructions.

6112-9. CALIBRATION

6112-10. Calbration for the TCX0 (Option -112) time base necessitates the use of a frequency reference with an accuracy of $\pm 1 \times 10^{9}$. A cesium standard, such as the HP 5061A, is recommended. This calibration procedure calls for applying the reference frequency to Channel A and adjusting the time base for a counter display of the known input. At the 0.1 Hz RESOLUTION setting on the counter, this method yields an adjustable accuracy of ±5 parts in 108 (± one count error). Proceed with the following steps:

1. Ensure that the counter's top and bottom covers are installed.

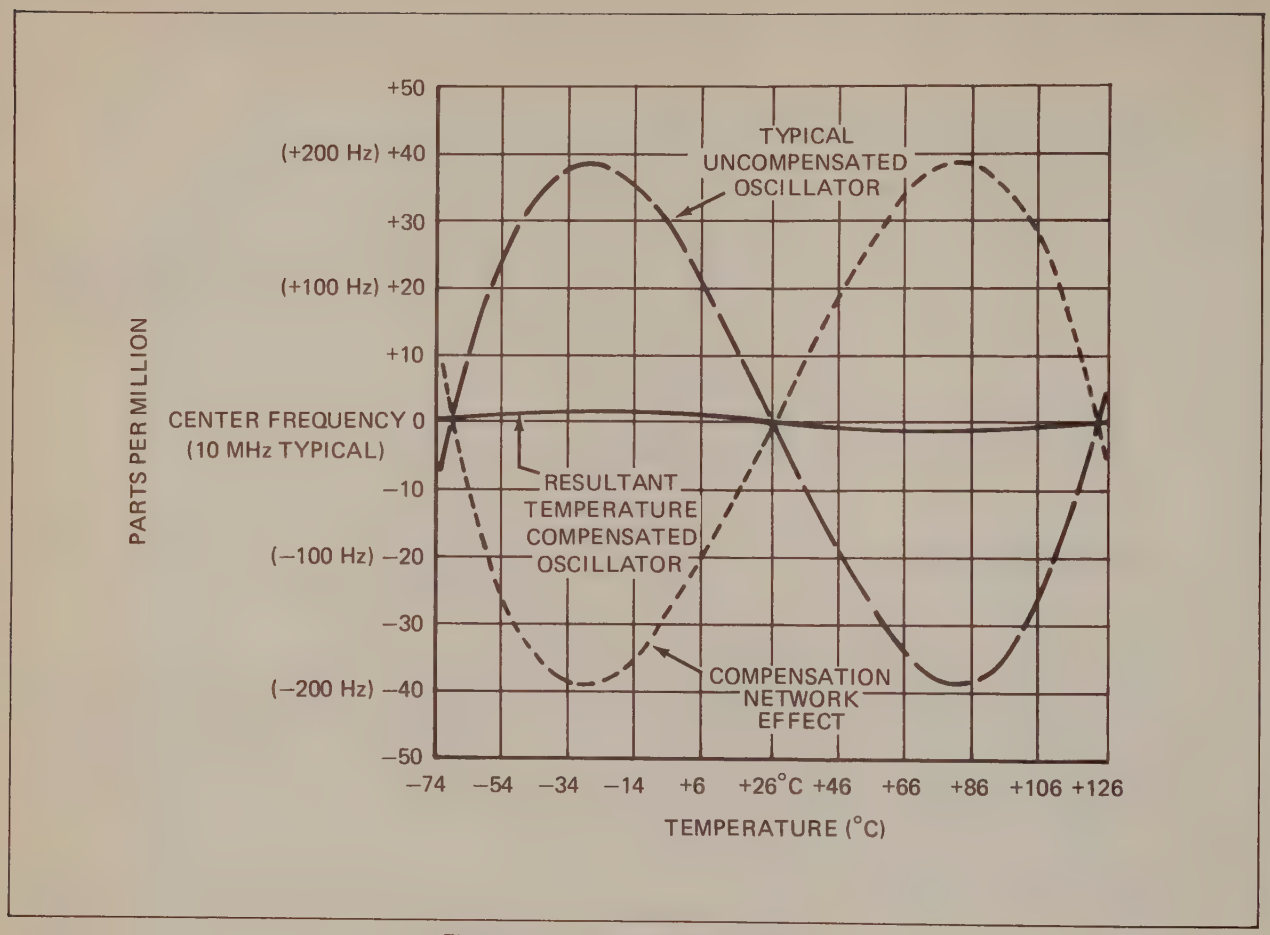


Figure 6112-1. Compensation Effects

Table 6112-1. Option 72XXA-112 Specifications

Nominal Frequency	10 MHz
Aging Rate	$\pm 3 \times 10^{-7}$/month $\pm 1 \times 10^{-6}$/year
Accuracy with Temperature (0° to 50°C)	$\pm 2 \times 10^{-6}$
Line Voltage (10% line variation)	$\pm 2 \times 10^{-8}$
Battery Operation	$\pm 2 \times 10^{-8}$

2. Apply power to the counter and allow for a minimum warmup of 2 hours.

3. Set counter controls and connections as defined in Section 4 of this manual ("Time Base Calibration").

4. Connect the 5 MHz (100 mV) frequency reference output to CHANNEL A input on the counter.

5. If necessary, adjust the time base so that the counter's display corresponds to the first reading presented in Table 6112-2. The adjustment is accessed through a hole in the left rear corner of the bottom case half. Use a JFD 5284 (or equivalent) non-ferrous adjustment tool. If installed at the rear of the bottom case half, the bail will have to be removed to allow access.

6. Change the counter's RESOLUTION setting to the next step listed in Table 6112-2 and repeat step (5) for the respective display. Display update in the 0.1 Hz setting occurs every 10 seconds.

NOTE

When the OVFL LED is illuminated, observed the GATE LED (on) to verify that a measurement is being made.

Table 6112-2. Calibration

RESOLUTION	DISPLAY (±2 COUNT)
1 Hz	5000.000 kHz (7250A, 7260A, 7261A)
0.1 Hz	000.0000 kHz* (7250A) 5000.0000 kHz (7260A, 7261A)

6112-11. REPLACEABLE PARTS

6112-12. The 72XX-112 Option is a completely sealed unit containing no replacement parts. A replacement can be ordered by using Fluke Part Number 516138. The insulator can be ordered seperately by using Fluke Part Number 487710.

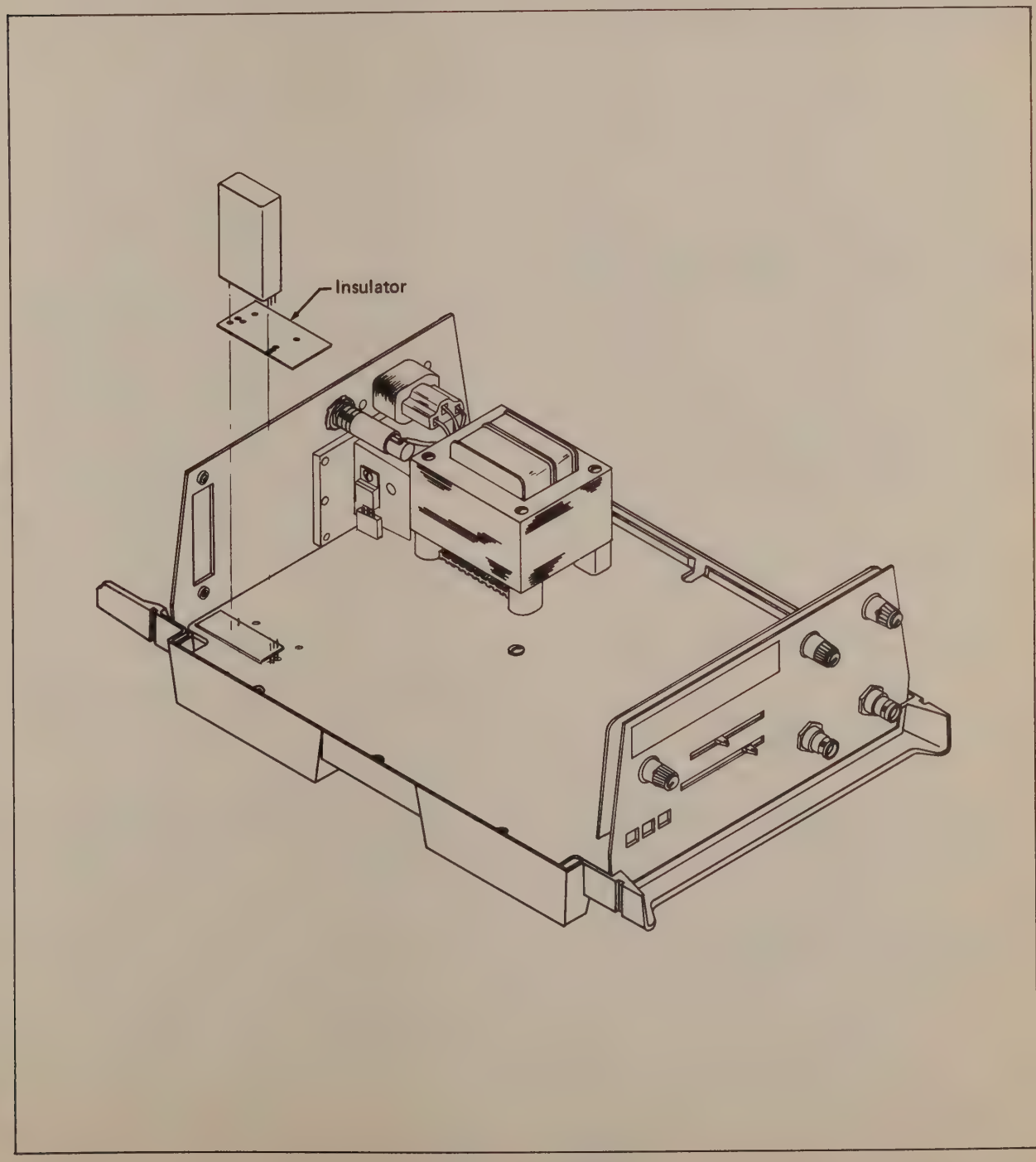


Figure 6112-2. Installation

Option-131
Low Power Oven Time Base

131-1. INTRODUCTION

131-2. The -131 Option is a crystal oscillator inside a temperature stabilized oven. The oven uses an extremely small amount of power. After the assembly is warmed up, power consumption is 1 watt, typically. This allows oven controlled time base accuracy with a battery powered instrument. Operation and Calibration of an instrument equipped with the -131 Option is the same as with a standard instrument. Refer to Sections 2 and 4 of this manual for additional information.

131-3. SPECIFICATIONS

131-4. The specifications of the -131 Option are listed in Table 131-1.

131-5. INSTALLATION

6131-6. Installation of the Low Power Oven Time Base (Option -131) necessitates removal of the counter's Main PCB; refer to disassembly instructions included with Section 4. For each counter, the Low Power Oven Time Base is installed in the top left rear corner of the Main PCB. Use the following installation procedure:

1. Unsolder and remove any other time base already installed.

2. Referring to Figure 131-1, install the Low Power Oven Time Base and insulator. Use the provided hardware to secure the time base to the Main PCB.

3. While exercising care not to overheat the Main PCB, solder the time base connections.

4. Complete jumper and solder bridge arrangements on the Main PCB as described below:

a. 7220A: If necessary, remove the short at SB4 and jumper SB5 (bottom of Main PCB, left rear corner). Jumper SB2 (bottom, left front corner).

b. 7250A: If necessary, remove the short between W1 and +12V and jumper W1 to +5V (top of Main PCB, left front corner). Jumper SB2 (bottom of Main PCB, left front corner).

c. 7260A or 7261A: Remove the short at SB5 and jumper SB4 (bottom of Main PCB, left rear). Jumper SB2.

Table 131-1. -131 Option Specifications

Nominal Frequency	10 MHz
Aging Rate	1×10^{-7}/month*
Accuracy with Temperature (0° to 40°C)	$\pm 1 \times 10^{-7}$
Line Voltage (10% line variation)	2×10^{-8}
Warmup**	
10 minutes	5×10^{-7}
20 minutes	3×10^{-8}
Battery Operation	$\pm 5 \times 10^{-8}$

* After 5 days continuous operation.
** Specifies offset from final frequency value (the value after 24 hours).

131-7. CALIBRATION

131-8. Calibration for the Low Power Oven Time Base necessitates the use of a frequency reference with an accuracy of $\pm 1 \times 10^{-9}$. A cesium standard, such as the HP

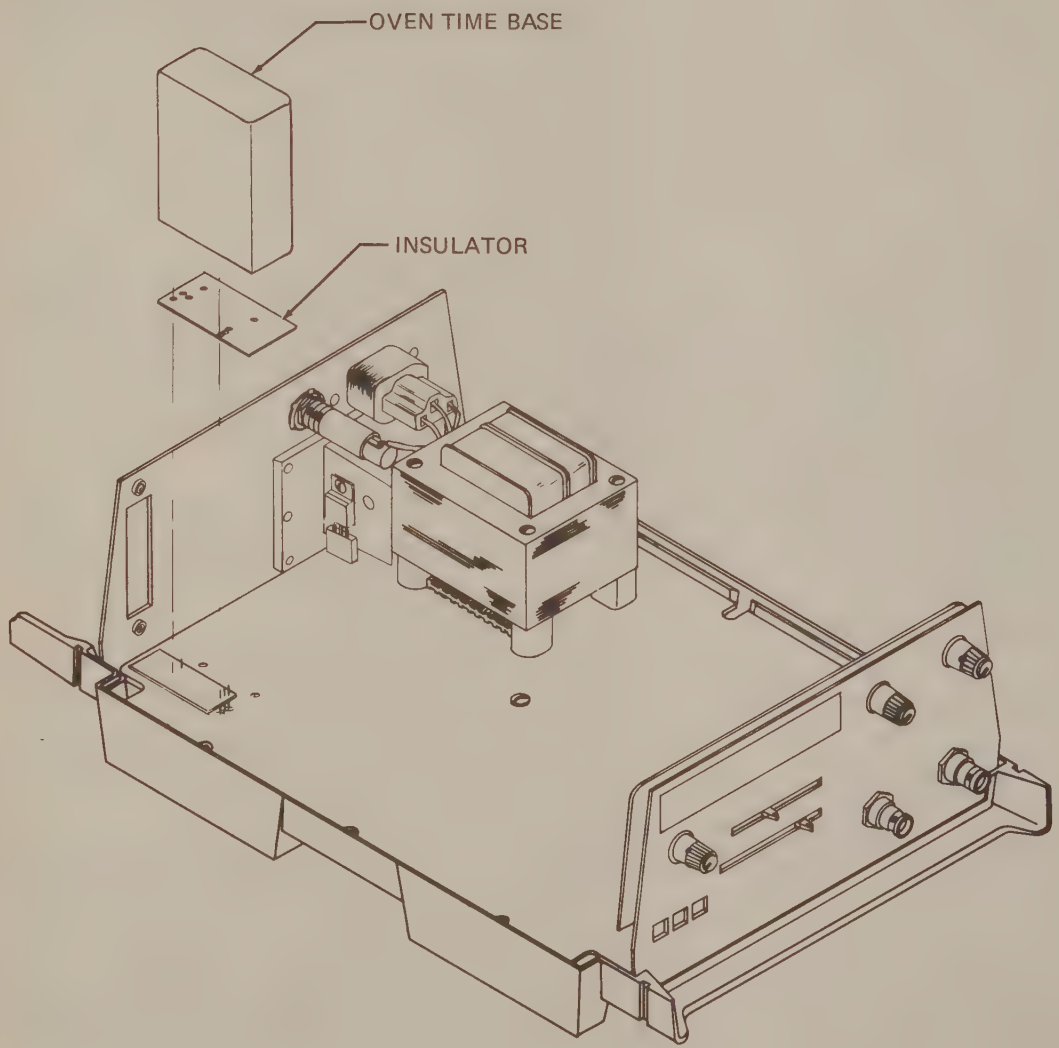


Figure 131-2. Installation

5061A, is recommended. This calibration procedure calls for applying the reference frequency to Channel A and adjusting the time base for a counter display of the known input. At the 0.1 Hz RESOLUTION setting on the counter, this method yields an adjustable accuracy of 2 parts in 10^8 (± one count error). Proceed with the following steps:

1. Ensure that the counter's top and bottom covers are installed.

2. Apply power to the counter and allow for a minumum warmup of 20 minutes. When possible a warmup of 24 hours is preferred.

3. Set counter controls and connections as defined in Section 4 of this manual ("Time Base Calibration").

4. Connect the 5 MHz (100 mV) frequency reference output to CHANNEL A input on the counter.

5. If necessary, adjust the time base so that the counter's display corresponds to the first reading presented in Table 6131-2. The adjustment is accessed through a hole in the left rear corner of the bottom case half. Use a JFD 5284 (or equivalent) non-ferrous adjustment tool. If installed at the rear of the bottom case half, the bail will have to be removed to allow access.

6. Change the counter's RESOLUTION setting to the next step listed in Table 6131-2 and repeat step (5) for the respective display. Display update in the 0.1 Hz setting occurs every ten seconds.

NOTE

When the OVFL LED is illuminated, observe the GATE LED (on) to verify that a measurement is being made.

6131-9. LIST OF REPLACEABLE PARTS

131-10. A replacement oscillator can be ordered by using Fluke Part Number 516112. The Manufacturer's Federal Supply Code is 89536 and the Manufacturer's Part Number is 516112. The insulator can be ordered with part number 487710. Refer to Section 5 for ordering information.

Table 131-2. Calibration

RESOLUTION	DISPLAY (±1 COUNT)
1 Hz	5000.000 kHz (7250A, 7260A, 7261A) 5.000000 MHz (7220A)
0.1 Hz	000.0000 kHz* (7250A) 5000.0000 kHz (7260A, 7261A) 5.0000000 MHz (7220A)

Option -132
Superior Low Power Oven Time Base

132-1. INTRODUCTION

132-2. The -132 Option is a crystal oscillator inside a temperature stabilized oven. The oven uses an extremely small amount of power. After the assembly is warmed up, power consumption is 1 watt, typically. This allows oven controlled time base accuracy with a battery powered instrument. Operation and Calibration of an instrument equipped with the -132 Option is the same as with a standard instrument. Refer to Sections 2 and 4 of this manual for additional information.

132-3. SPECIFICATIONS

132-4. The specifications of the -132 Option are listed in Table 132-1.

132-5. INSTALLATION

132-6. Installation of the Superior Low Power Oven Time Base (Option -132) necessitates removal of the counter's Main PCB; refer to disassembly instructions included with Section 4. For each counter, the Superior Low Power Oven Time Base is installed in the top left rear corner of the Main PCB. Use the following installation procedure:

1. Unsolder and remove any other time base already installed.

2. Referring to figure 132-1, install the Superior Low Power Oven Time Base and insulator. Use the provided hardware to secure the time base to the Main PCB.

3. While exercising care not to overheat the Main PCB, solder the time base connections.

4. Complete jumper and solder bridge arrangements on the Main PCB as described below:

a. 7220A: If necessary, remove the short at SB4 and jumper SB5 (bottom of Main PCB, left rear corner). Jumper SB2 (bottom, left front corner).

b. 7250A: If necessary, remove the short between W1 and +12V and jumper W1 to +5V (top of Main PCB, left front corner). Jumper SB2 (bottom of Main PCB, left front corner).

c. 7260A or 7261A: Remove the short at SB5 and jumper SB4 (bottom of Main PCB, left rear). Jumper SB2.

Table 132-1. -132 Option Specifications

Nominal Frequency	10 MHz
Aging Rate	$\pm 3 \times 10^{-9}$/day*
	$\pm 5 \times 10^{-8}$/month*
Accuracy with Temperature (0° to 40°C)	$\pm 3 \times 10^{-8}$
Line Voltage (10% line variation)	$\pm 4 \times 10^{-9}$
Warmup	
10 minutes	$\pm 5 \times 10^{-7}$
20 minutes	$\pm 3 \times 10^{-8}$
Battery Operation	$\pm 1 \times 10^{-8}$

* After 5 days continuous operation.
** Specifies offset from final frequency value (the value after 24 hours).

132-7. CALIBRATION

132-8. Calibration for the Superior Low Power Oven Time Base necessitates the use of a frequency reference

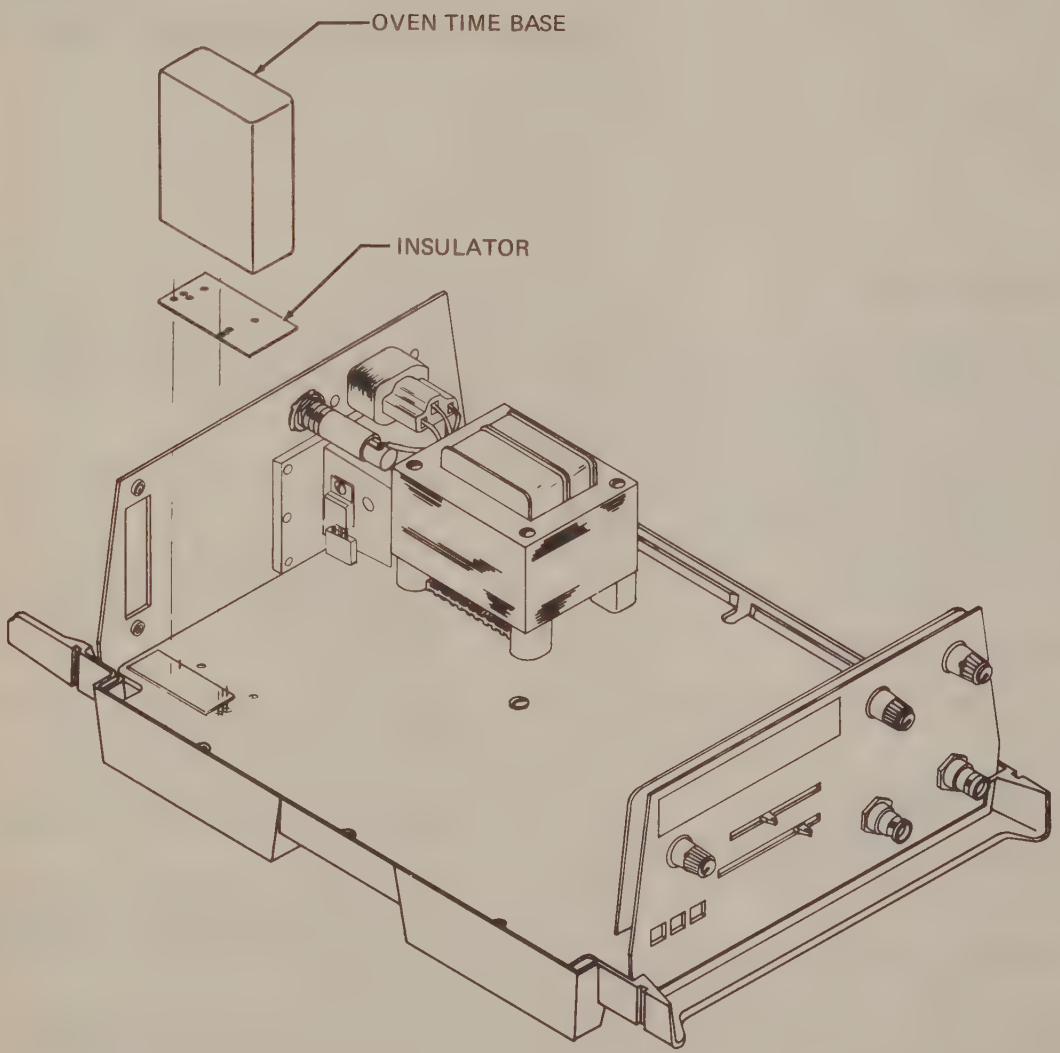


Figure 132-1. Installation

with an accuracy of ±1 X 10^9. A cesium standard, such as the HP 5061A, is recommended. This calibration procedure calls for applying the reference frequency to Channel A and adjusting the time base for a counter display of the known input. At the 0.1 Hz RESOLUTION setting on the counter, this method yields an adjustable accuracy of 2 parts in 10^8 (±1 count error). Proceed with the following steps:

1. Ensure that the counter's top and bottom covers are installed.

2. Apply power to the counter and allow for a minumum warmup of 20 minutes. When possible a warmup of 24 hours is preferred.

3. Set counter controls and connections as defined in Section 4 of this manual ("Time Base Calibration").

4. Connect the 5 MHz (100 mV) frequency reference output to CHANNEL A input on the counter.

5. If necessary, adjust the time base so that the counter's display corresponds to the first reading presented in Table 132-2. The adjustment is accessed through a hole in the left rear corner of the bottom case half. Use a JFD 5284 (or equivalent) nonferrous adjustment tool. If installed at the rear of the bottom case half, the bail will have to be removed to allow access.

6. Change the counter's RESOLUTION setting to the next step listed in Table 132-2 and repeat step (5) for the respective display. Display update in the 0.1 Hz setting occurs every ten seconds.

NOTE

When the OVFL LED is illuminated, observe the GATE LED (on) to verify that a measurement is being made.

132-9. LIST OF REPLACEABLE PARTS

132-10. A replacement oscillator can be ordered by using the Fluke Part Number 516096. The Manufacturer's Federal Supply Code is 89536 and the Manufacturer's Part Number is 516096. The insulator can be ordered with Fluke Part Number 487710. Ordering information is given in Section 5 of the Instruction Manual.

Table 6132-2. Calibration

RESOLUTION	DISPLAY (±1 COUNT)
1 Hz	5000.000 kHz (7250A, 7260A, 7261A) 5.000000 MHz (7220A)
0.1 Hz	000.0000 kHz* (7250A) 5000.0000 kHz (7260A, 7261A) 5.0000000 MHz (7220A)

-190 Option
Jittered Time Base

6190-1. INTRODUCTION

6190-2. The 7261A-190 Jittered Time Base Option is a noise source used to introduce phase jitter on the 100 MHz clock output of the 10-100 MHz Multiplier PCB when TIA A-B function is selected. The TIA statistical function must be random to insure the best results. This option produces the random factor.

6190-3. OPERATION

6190-4. The Jittered Time Base Option does not affect operation of the instrument.

6190-5. THEORY OF OPERATION

6190-6. The noise generator is composed of CR1, Q7, Q8 and their associated components. Amplifier U1 shapes the noise signal and allows only noise of a specific bandpass through. R9, Noise Level Adjust, controls the amplifier gain. The TIA command via J8-7, enables the noise signal to be output on J8-8 to the 10-100 MHz Multiplier PCB.

6190-7. INSTALLATION

6190-8. To install the -190 Option, use the following procedure:

1. Place the POWER ON/STBY switch in the STBY position.

2. Remove the top case cover using the Disassembly procedure in Section 4.

3. Plug the Jittered Time Base PCB Assembly into P8 on the Main PCB.

4. Replace the top case cover.

6190-9. CALIBRATION

6190-10. Use the following procedure to adjust the Noise Level Adjustment, R9. Use the JF 8040 or equivalent for the True RMS Voltmeter.

1. Set the instrument controls as follows:

FUNCTION	- TIA A-B
RESOLUTION	- AUTO
MODE	- CONT
REF	- INT

2. Connect the True RMS Voltmeter to TP2 on the 10-100 MHz Multiplier PCB.

3. Adjust R9 (Noise Level Adjustment) on the Jittered Time Base PCB until the RF Voltmeter display is 275 mV ±30 mV.

6190-11. LIST OF REPLACEABLE PARTS

6190-12. Table 6190-1 is a list of replaceable parts for the -190 Jittered Time Base PCB Assembly. Figure 6190-1 is a component location diagram.

Table 6190-1. Jittered Time Base Option

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG. PART NO.	TOT QTY	REC QTY	NOTE
-190	JITTERED TIMEBASE ASSEMBLY FIGURE 6190-2 (7261A-4004T)	ORDER	BY	OPTION -190			
C1	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	5		
C2	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C3	CAP, POLY FILM, 0.82 UF +/-10%, 100V	478644	80031	C280MAH/A820K	2		
C4	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C5	CAP, POLY FILM, 0.033 +/-10%, 250V	357954	73445	C280MAE/A33K	1		
C6	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C7	CAP, MICA, 10 PF +/-10%, 500V	175216	72136	DM15C100K	1		
C8	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C9	CAP, POLY FILM, 0.82 UF +/-10%, 100V	478644	80031	C280MAH/A820K	REF		
CR1	DIODE, SI, LOW-NOISE	478024	89536	478024	1	1	
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	1	1	
J8	CONN, RECEPTACLE	375329	00779	85863-3	8		
L1	CHOKE, 6-TURN	320911	89536	320911	2		
L2	CHOKE, 6-TURN	320911	89536	320911	REF		
MP1	JACK, CONNECTOR	149112	74790	105-0753	1		
Q1	XSTR, SI, NPN	295717	24355	AD811-00117	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	3	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q4	XSTR, SI, PNP	195974	04713	2N3906	4	1	
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
R1	RES, MTL. FILM, 60.4K +/-1%, 1/8W	291419	91637	CMF556042F	2		
R2	RES, DEP. CAR, 33K +/-5%, 1/4W	348888	80031	CR251-4-5P33K	1		
R3	RES, DEP. CAR, 1.8K +/-5%, 1/4W	441444	80031	CR251-4-5P1K8	1		
R4	RES, DEP. CAR, 8.2K +/-5%, 1/4W	441675	80031	CR251-4-5P8K2	2		
R5	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	2		
R6	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R7	RES, DEP. CAR, 330K +/-5%, 1/4W	376640	80031	CR251-4-5P330K	1		
R8	RES, DEP. CAR, 8.2K +/-5%, 1/4W	441675	80031	CR251-4-5P8K2	REF		
R9	RES, VAR, CER, 10K +/-10%, 1/2W	285171	89536	285171	1	1	
R10	RES, DEP. CAR, 1.5K +/-5%, 1/4W	343418	80031	CR251-4-5P1K5	1		
R11	RES, DEP. CAR, 22K +/-5%, 1/4W	348870	80031	CR251-4-5P22K	2		
R12	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	2		
R13	RES, DEP. CAR, 22K +/-5%, 1/4W	348870	80031	CR251-4-5P22K	REF		
R14	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	REF		
R15	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	2		
R16	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	1		
R17	RES, MTL. FILM, 10K +/-1%, 1/8W	168260	91637	CMF551002F	2		
R18	RES, MTL. FILM, 255 +/-1%, 1/8W	355081	91637	CMF552550F	2		
R19	RES, MTL. FILM, 255 +/-1%, 1/8W	355081	91637	CMF552550F	REF		
R20	RES, MTL. FILM, 34K +/-1%, 1/8W	261602	91637	CMF553402F	1		
R21	RES, MTL. FILM, 11K +/-1%, 1/8W	293621	91637	CMF553402F	2		
R22	RES, MTL. FILM, 2.61K +/-1%, 1/8W	289983	91637	CMF552611F	1		
R23	RES, MTL. FILM, 11K +/-1%, 1/8W	293621	91637	CMF553402F	REF		
R24	RES, MTL. FILM, 10K +/-1%, 1/8W	168260	91637	CMF551002F	REF		

Table 6190-1. Jittered Time Base Option (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R25	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R26	RES, MTL. FILM, 412K +/-1%, 1/8W	379198	91637	CMF554123F	1		
R27	RES, TEMP, SENS, 10K +/-10%	104596	15801	JA41J1	1		
R28	RES, DEP. CAR, 3.6K +/-5%, 1/4W	442343	80031	CR251-4-5P3K6T	1		
R29	RES, MTL. FILM, 60.4K +/-1%, 1/8W	291419	91637	CMF556042F	REF		
U1	IC, OPERATIONAL AMPLIFIER	271502	12040	LM301A	1	1	

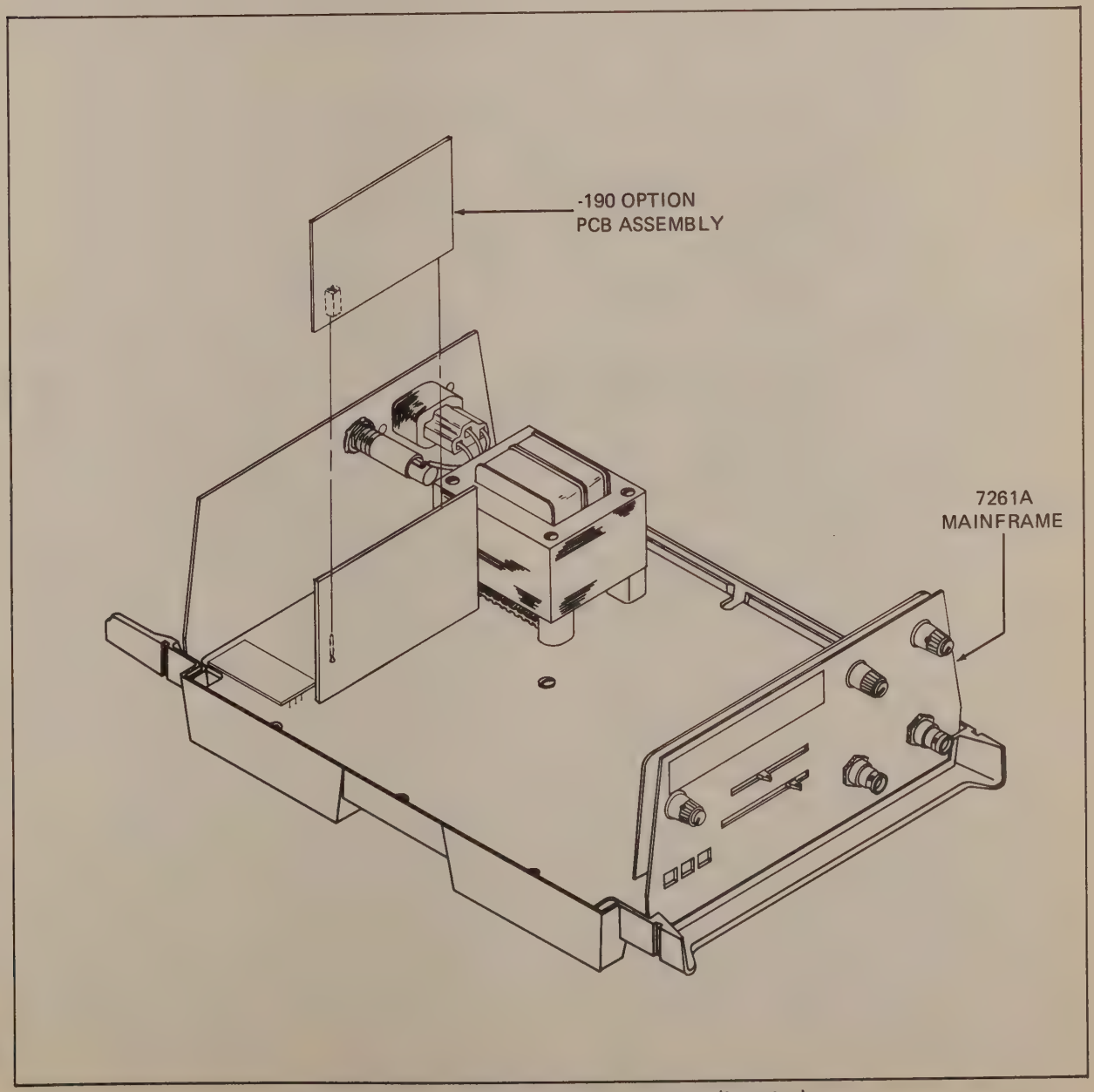


Figure 6190-1. Jittered Time Base PCB Assembly (Location)

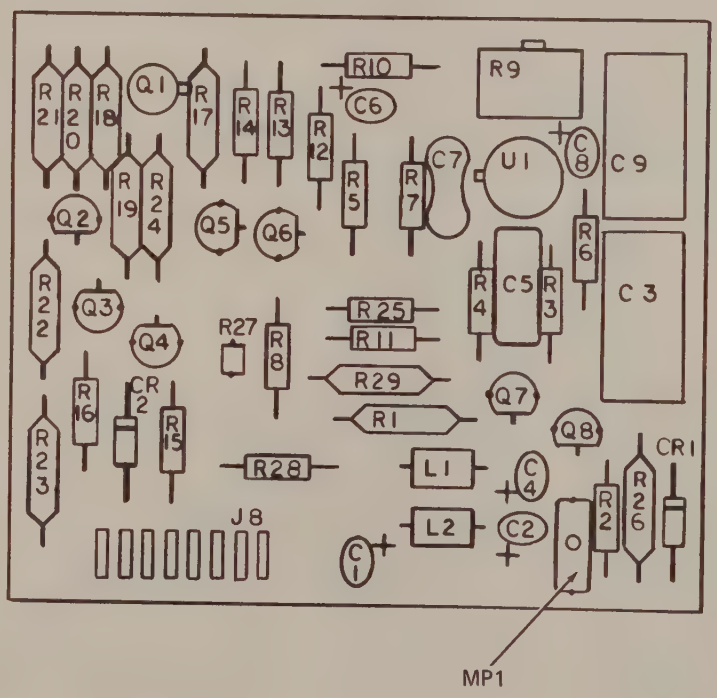


Figure 6190-2. Jittered Time Base PCB Assembly

-310 Option
520 MHz Direct

6310-1. INTRODUCTION

6310-2. The -310 Option can directly measure the frequency of signals from 50-520 MHz. The option uses the Channel C input terminal. There are no controls for this channel. Input impedance is 50Ω to improve VSWR. The input is fuse protected by F1 on the 520 MHz Direct PCB. A spare fuse is provided on the pcb.

6310-3. OPERATION

6310-4. To use the -310 Option, set the FUNCTION control on the Front Panel of the instrument to the FREQ C position. Connect the unknown signal to the Channel C input terminal. Set the RESOLUTION control to the desired range.

6310-5. THEORY OF OPERATION

6310-6. As Figure 610-1 shows, the 520 MHz Direct PCB conditions the input signal on Channel C and provides a high speed counter for the first decade of counting. The input signal applied to the Channel C terminal is ac-coupled and fuse protected to the input of the signal conditioner. As the FUNCTION switch is moved to the FREQ C position, the instrument generates a general Reset pulse that also reset the Sync Gate and first decade counter on the 520 MHz Direct PCB. When the FUNCTION switch is in the FREQ C position, the logic terms FC and $\overline{FC}$ are decoded by the Function ROM U42 on the Main PCB. FC and $\overline{FC}$ work together to select the proper Main Gate Enable logic, timing logic, control logic, turn off the Channel A and Channel B Signal Conditioners, and (through K1) turn on the 520 MHz Direct PCB. The signal input on Channel C is processed through the signal conditioner and applied to the first decade counter, U2, (a special high speed counter) and to the Threshold Detection Circuit. If the amplitude of the signal applied to the Channel C input is above 8 mV rms (approximately), the Threshold Detector will enable the Sync Gate and 1st Decade Counter. Should the amplitude of the Channel C input fall below 6 mV rms (approximately), the Threshold Detector immediately disables the Sync Gate and 1st Decade Count. The measurement is stopped. When the instrument generates $\overline{GQ}$, the 100 kHz signal from the time base dividers acting through the sync gate on the 520 MHz Direct PCB, enables the first decade counter. The carry output of the first decade counter (5-50 MHz) is routed through the Clock Select on the Main PCB to the first decade counter on the Main PCB. This counter is used to count the second decade for FREQ C measurements (it normally counts signals up to 125 MHz) the second decade counter on the Main PCB is bypassed. This is accomplished by the $\overline{C\ DIRECT}$ signal (a ground) from the 520 MHz Direct PCB being ANDed with $\overline{FC}$. The resulting logic term disqualifies the MUX on the Main PCB and qualifies the MUX on the 520 MHz Direct PCB. The outputs of the first decade counter on the 520 MHz Direct PCB (first decade) and the output of the first decade counter on the Main PCB (second decade) are routed through the MUX on the 520 MHz Direct PCB to the counter, U15, on the Main PCB and from there to the Display as usual.

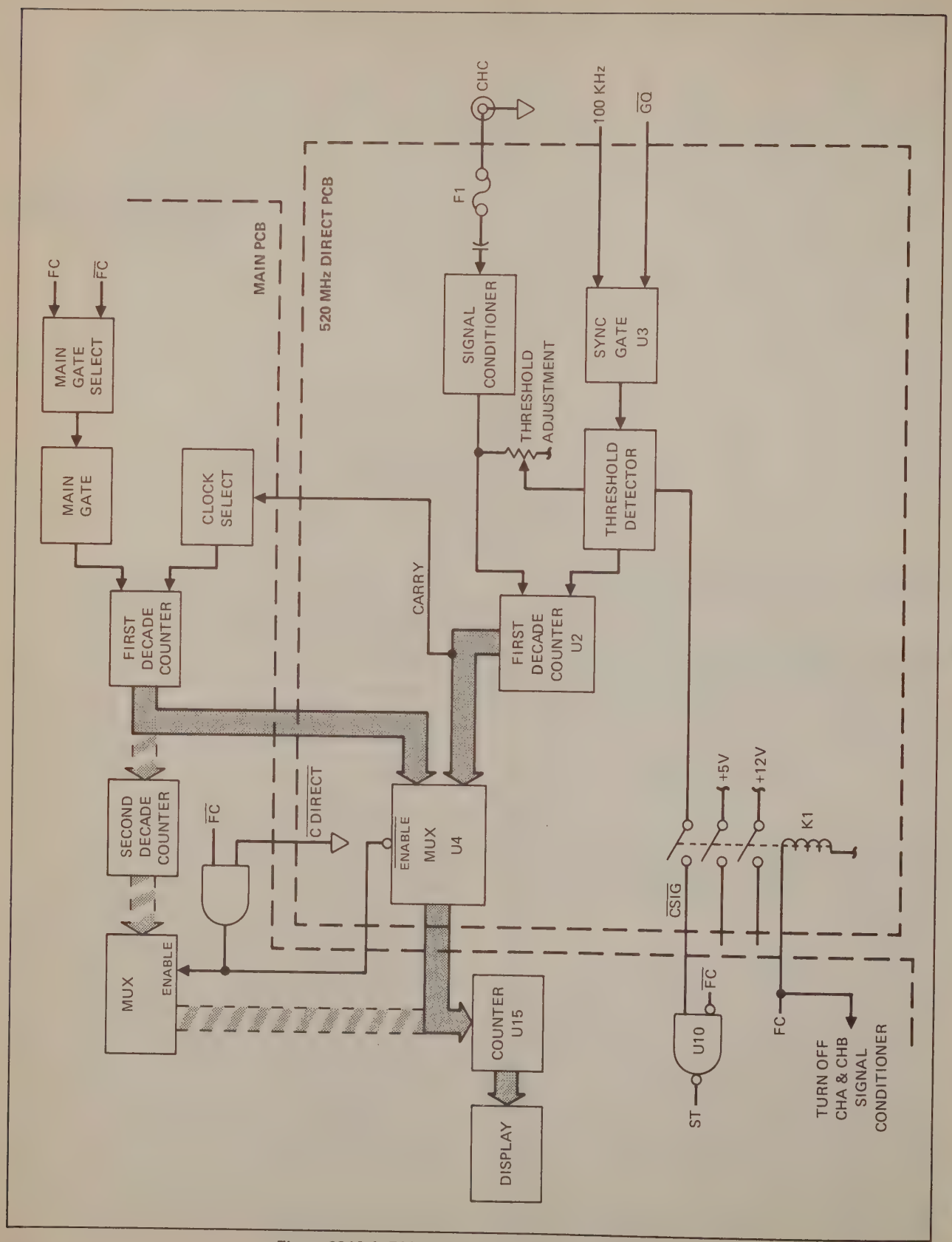


Figure 6310-1. 520 MHz Direct Basic Block Diagram

6310-7. INSTALLATION

6210-8. As Figure 6310-2 shows, the option includes both the 520 MHz Direct PCB and the Channel C input cable. Use the following procedure to install the option:

1. Set the AC POWER switch to the OFF position and remove the line power cord.

2. Using the Disassembly procedure given in Section 4, remove the Front Panel Assembly, then:

a. As shown in Figure 6310-3, unscrew the Front Panel PCB from the Front Panel.

b. Remove the plug button from the Channel C input terminal hold.

c. Mount the BNC plug of the Channel C cable.

WARNING

MAKE SURE THAT THE NUT (SHOWN AS FLAG C) FLAT IS PARALLEL WITH THE BOTTOM OF THE FRONT PANEL OR IT WILL INTERFERE WITH THE SLIDE SWITCHES.

d. Mount the BNC insert using the large nut.

e. Fasten the Front Panel PCB to the the Front Panel.

f. Reconnect the Front Panel Assembly to the Main PCB.

3. Fasten the Channel C cable to the connector on the 520 MHz Direct PCB.

4. Plug the 520 MHz Direct PCB into P6 on the Main PCB.

5. Mount the Main PCB onto the bottom case cover of the instrument.

6. Mount the top case cover of the instrument.

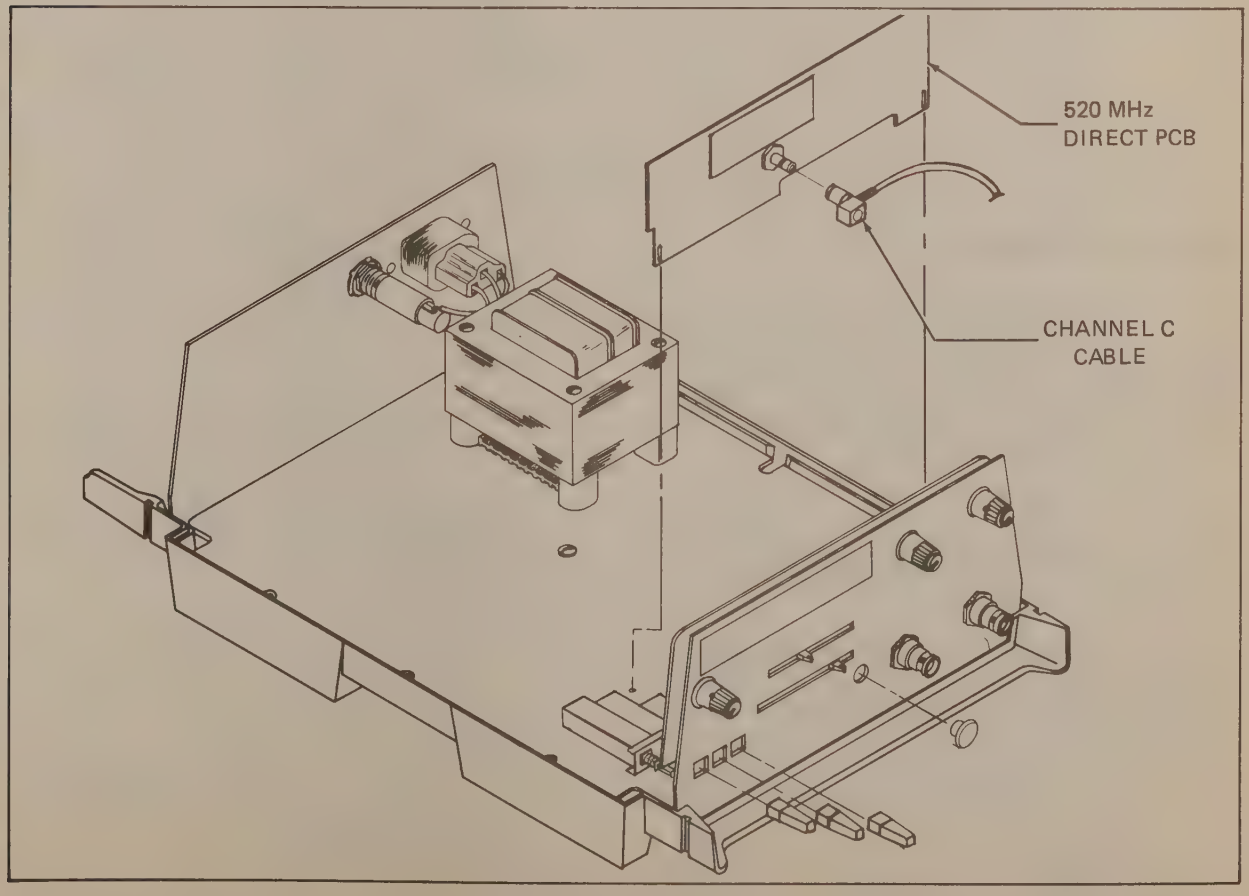


Figure 6310-2. Installation - I

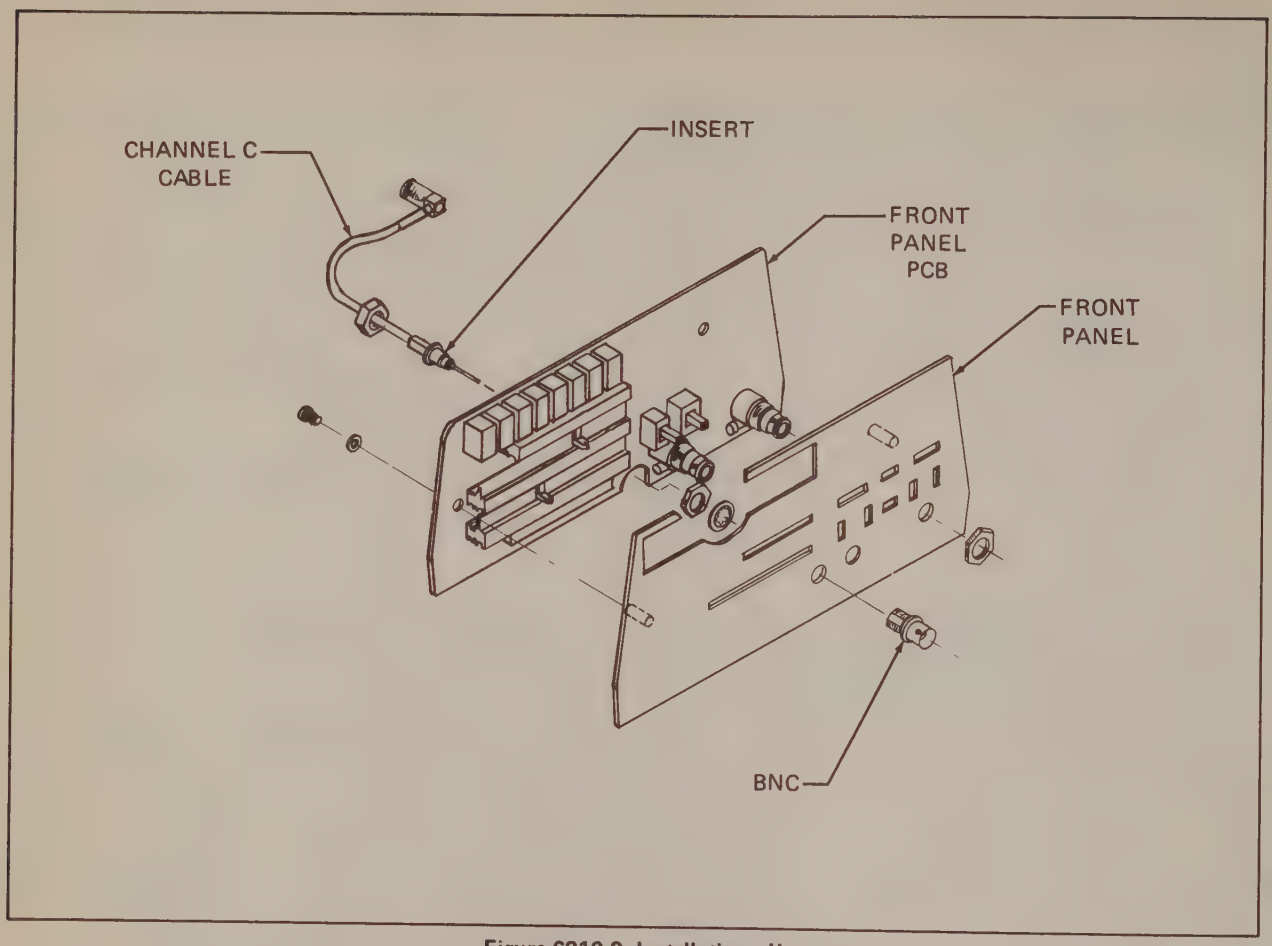


Figure 6310-3. Installation - II

6310-9. Fuse Replacement

6310-10. The input protection fuse F1 is a special fast blow fuse. Should the fuse fail, a spare is provided on the 520 MHz Direct PCB and is labeled F2. Should both fuses fail, replace them with the fuse specified in the List of Replaceable Parts (Table 6310-2).

6310-11. PERFORMANCE CHECK

6310-12. Use the HP 8660B Signal Generator (with 11661B) and the following procedure to check the performance of the 520 MHz Direct PCB.

1. Set the Front Panel controls of the instrument to the following positions:

FUNCTION	- FREQ C
RESOLUTION	- 10 Hz

2. Set the Rear Panel controls to the following positions:

REF	- EXT
MODE	- CONT

3. Connect the the equipment as shown in Figure 6310-4.

4. Program the Signal Generator for the output frequencies listed in Table 6310-1 at the following levels into the UUT:

   a. 10 mV rms.

   b. 10 dB down from the level in a.

5. Verify that the UUT display:

   a. In 4a, agrees with the frequency programmed into the Signal Generator for each step of Table 6310-1.

   b. In 4b, goes to all zeros.

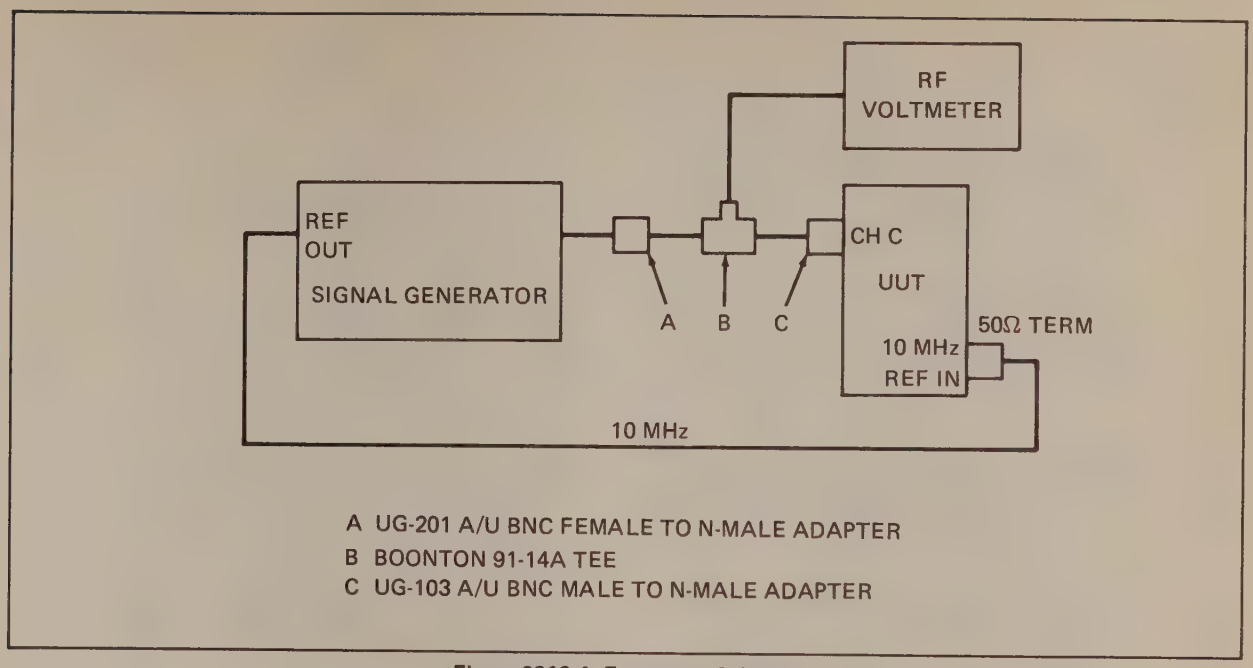


Figure 6310-4. Frequency C Check

Table 6310-1. Performance Check

PROGRAMMED FREQUENCY (in MHz)	DISPLAY (in kHz)	ERROR (in COUNTS)
50	50000.00	
100	100000.00	
150	150000.00	
200	200000.00	
250	250000.00	
300	300000.00	±1
350	350000.00	
400	400000.00	
450	450000.00	
500	500000.00	
520	520000.00	

6310-13. Threshold Adjustment

6310-14. Use the following procedure to set the Threshold Adjustment to the proper value:

1. Perform steps 1 and 2 of the Performance Check.

2. Program the Signal Generator for an input to the UUT of 250 MHz at a level of 7 mV rms.

3. Adjust the Threshold Adjust (R23) for a stable display with the GATE light flashing.

4. Verify that the UUT display is 250000.00 kHz ±1 count.

5. If the adjustment cannot be made, reprogram the Signal Generator for a higher level. If the adjustment cannot be made with the HF synthesizer programmed for an output level of 10 mV rms or less, troubleshooting and repair is indicated.

6310-15. LIST OF REPLACEABLE PARTS

6310-16. Table 6310-2 is a list of replaceable parts for the -310 Option. Figure 6310-5 is a component location diagram of the 520 MHz Direct PCB.

Table 6310-2. Direct Channel C Assembly, 520 MHz

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
-310	DIRECT CHANNEL C ASSEMBLY, 500MHZ FIGURE 6310-5 (7260A-4003T)	ORDER	BY	OPTION -310			
C1	CAP, TA, 68 UF +/-20%, 15V	193615	56289	196D686X0015TE4	1		
C2	CAP, TA, 47 +/-20%, 20V	348516	56289	196D476X0020TE4	1		
C3	CAP, TA, 22 UF +/-20%, 20V	161331	56289	196D226X0035HA1	3		
C4	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	6		
C5	CAP, TA, 20 UF +/-20%, 20V	161927	56289	196D2225X0020HA1	1		
C6	CAP, MICA, 82 +/-5%, 500V	148502	72136	DM15F820J	1		
C8	CAP, CER, .001 UF +/-20%, 100V	402966	32897	8121-A100-W5R-102M	4		
C9	CAP, CER, .001 UF +/-20%, 100V	402966	32897	8121-A100-W5R-102M	REF		
C10	CAP, CER, .01 UF +/-20%, 100V	407361	32897	8121-A100-W5R-103M	1		
C11	CAP, CER, .001 UF +/-20%, 100V	402966	32897	8121-A100-W5R-102M	REF		
C12	CAP, CER, .001 UF +/-20%, 100V	402966	32897	8121-A100-W5R-102M	REF		
C13	CAP, TA, 22 UF +/-20%, 35V	161331	56289	196D226X0035HA1	REF		
C14	CAP, TA, 22 UF +/-20%, 35V	161331	56289	196D226X0035HA1	REF		
C15	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C16	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C17	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C18	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C19	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
CR1	DIODE, ZENER	246611	07910	1N960B	1	1	
CR2	DIODE, HOT CARRIER	369595	07263	FH1100	4	1	
CR3	DIODE, HOT CARRIER	369595	07263	FH1100	REF		
CR4	DIODE, HOT CARRIER	369595	07263	FH1100	REF		
CR5	DIODE, HOT CARRIER	369595	07263	FH1100	REF		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	09214	IN4448	4	1	
CR7	DIODE, SI, HI-SPEED SWITCH	203323	09214	IN4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	09214	IN4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	09214	IN4448	REF		
F1	FUSE, 1/4 AMP	370577	75915	273.200	2	10	
F2	FUSE, 1/4 AMP	370577	75915	273.200	REF		
J2	CONNECTOR, BNC	352450	98291	51-051-0000	1		
J11	SOCKET, BERG, PCB MOUNTING, 40-PIN	376418	22526	75060-007	40		
K1	RELAY, DRY REED	494732	21317	E544X5	1		
L1	CHOKE, 6-TURN	320911	89536	320911	2		
L2	CHOKE, 6-TURN	320911	89536	320911	REF		
MP1	CONNECTOR, RECEPTACLE, BOARD MOUNT	375329	00779	85863-3	2		
MP2	CONNECTOR, SMA	352450	98291	51-051-0000	1		
Q1	XSTR, SI, NPN, HI-SPEED SATURATED SWITCH	369645	07263	2N4274	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q3	XSTR, SI, NPN, DARLINGTON TO-92	381798	12040	MPS A-13	1	1	
Q4	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	5		
R2	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	3		
R3	RES, DEP. CAR, 1.8K +/-5%, 1/4W	441444	80031	CR251-4-5P1K8	2		
R4	RES, DEP. CAR, 1.8K +/-5%, 1/4W	441444	80031	CR251-4-5P1K8	REF		
R5	RES, DEP. CAR, 5.1K +/-5%, 1/4W	368712	80031	CR251-4-5P5K1	1		
R6	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R7	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	1		

Table 6310-2. Direct Channel C Assembly, 520 MHz (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE		TOT QTY	REC QTY	NOTE
R8	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R9	RES, DEP. CAR, 160K +/-5%, 1/4W	442442	80031	CR251-4-5P160K	1		
R10	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R11	RES, DEP. CAR, 180K +/-5%, 1/4W	348946	80031	CR251-4-5P180K	2		
R12	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R13	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	1		
R14	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R15	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	2		
R16	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R17	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	4		
R18	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
R19	RES, DEP. CAR, 180K +/-5%, 1/4W	348946	80031	CR251-4-5P180K	REF		
R20	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
R21	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	2		
R22	RES, DEP. CAR, 220K +/-5%, 1/4W	348953	80031	CR251-4-5P220K	1		
R23	RES, VAR, 20K +/-10%, 1/2W	291609	11236	360S2034	1	1	
R24	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R25	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R26	RES, DEP. CAR, 47K +/-5%, 1/4W	348896	80031	CR251-4-5P47K	1		
R27	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6K2	3		
R28	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6K2	REF		
R29	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6K2	REF		
R30	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
RN1	RES, NETWORK, 10K +/-5%, 1/4W	364000	89536	364000	1	1	
U1	IC, LIN, OP-AMP, QUAD, COMPENSATED	402669	12040	LM324N	1	1	
U2	IC, HI-SPEED DIVIDER, 600 MHZ	428631	03797	SP8635B	1	1	
U3	IC, DUAL TYPE D, MSTR-SLAVE F/F	454959	04713	MC10131P	1	1	
U4	IC, TTL, LO-PWR, SCHOTTKY, TRI-ST	429902	12040	DM81LS95N	1	1	
U5	IC, LIN, QUAD COMPARATOR, 14-PIN DIP	387233	12040	LM339N	1	1	
U6	IC, DIG, PERIPHERAL DRIVER, 8-PIN DIP	393959	12040	DS75451AN	1	1	
U7	500 MHZ, PREAMP (TO J11)	476820	89536	476820	1		
W1	CABLE, COAX, 3 1/2 INCH	398461	89536	398461	1		
XF1	SOCKET, FUSE	403642	00779	50863-8	4		
XF2	SOCKET, FUSE	403642	00779	50863-8	REF		
XU2	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	1		

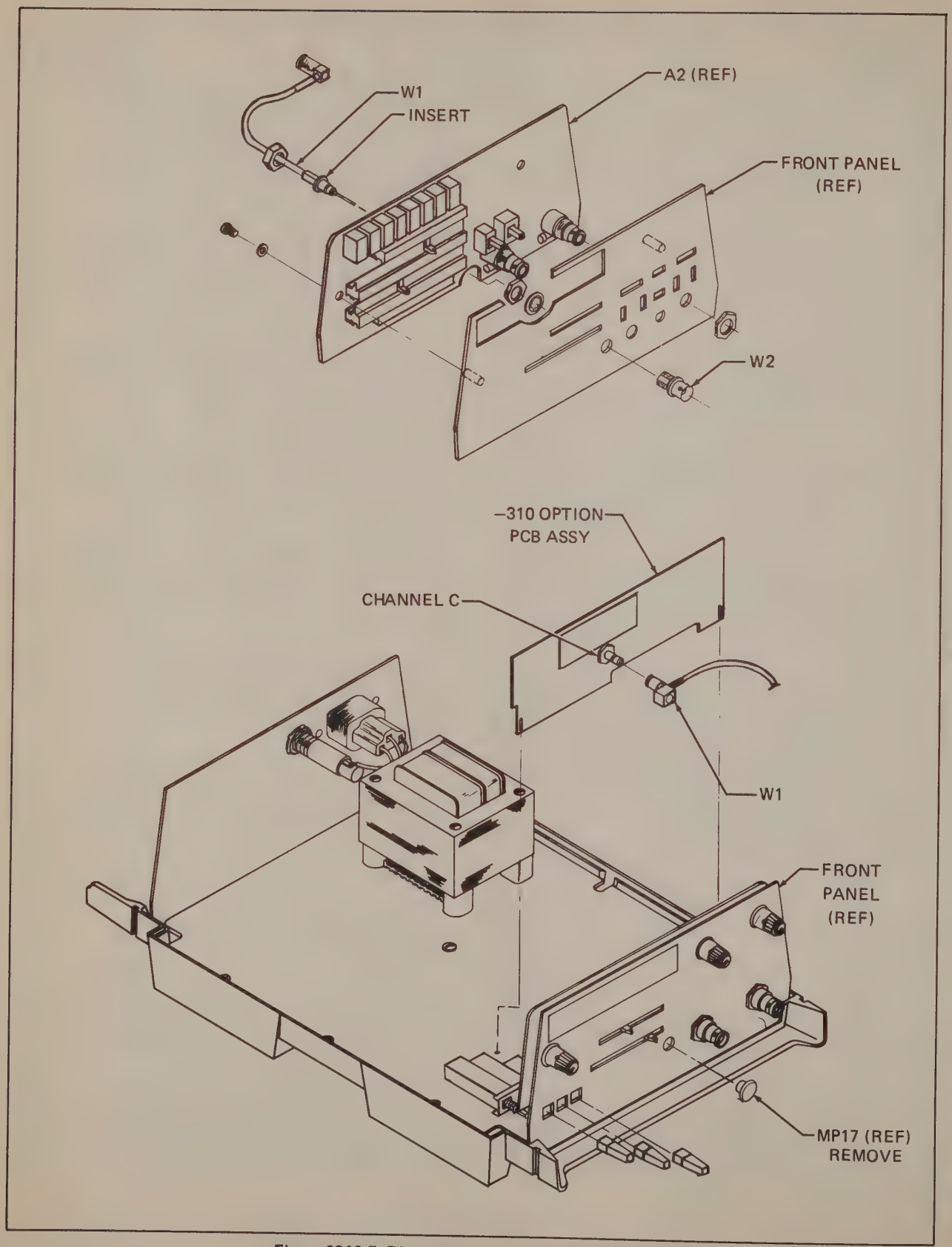


Figure 6310-5. Direct Channel C Assembly, 520 MHz

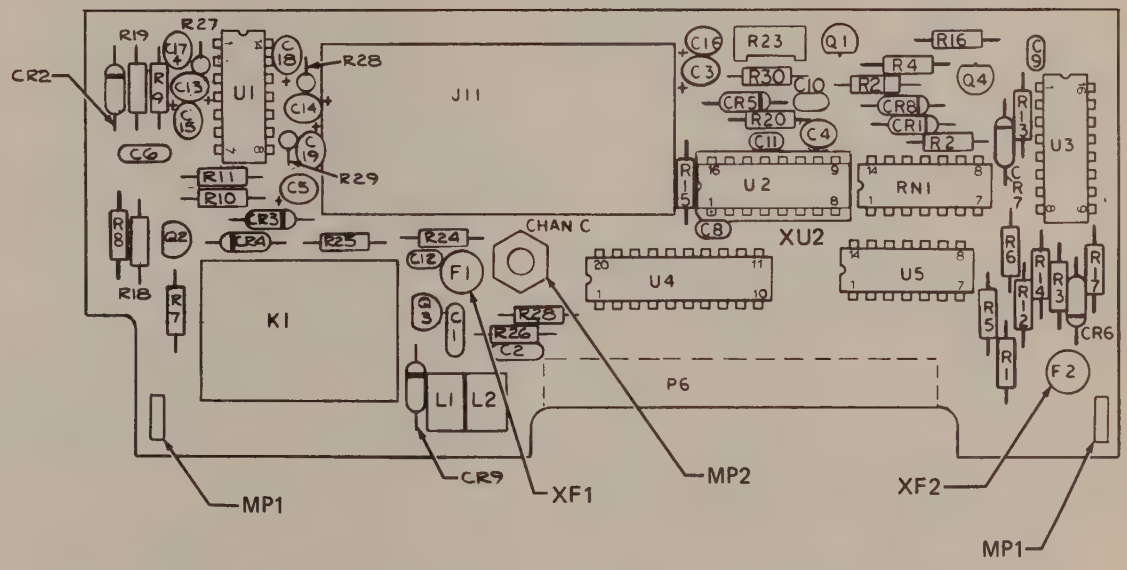


Figure 6310-5. Direct Channel C Assembly, 520 MHz (cont)

Option 72XXA-331
1300 MHz Prescaler

6331-1. INTRODUCTION

6331-2. The 72XXA-331 Option is a prescaler which extends the frequency range of the Fluke 7260A and 7261A counters to 1300 MHz. This prescaler operates from 100 MHz to 1300 MHz and has a sensitivity of 10 mV rms at 1000 MHz. Once installed, Channel C (CH C) becomes the front panel input for this option.

6331-3. As shown in Figure 6331-1, the option consists of one plug-in circuit board module (two printed circuit boards mated) and a front panel BNC jack with connecting cable. The -331 Option may be installed either at the factory or at a Fluke Service Center; however, it is not field installable. When ordering, use the option model number 72XXA-331.

6331-4. SPECIFICATIONS

6331-5. Specifications for the 1300 MHz Prescaler are listed in Table 6331-1.

6331-6. OPERATING INSTRUCTIONS

CAUTION

Keep Channel C input voltage levels below 5V rms to ensure proper operation. The prescaler is fuse-protected to prevent damage from signals above the safe operating range.

6331-7. To use the 1300 MHz Prescaler option, set the counter FUNCTION control to FREQ C and apply a signal to the CH C (Channel C) connector. All CHANNEL A and CHANNEL B controls and jacks are entirely disabled when in the Freq C mode and have no effect on the Channel C operation. The T.I. HOLDOFF (Time Interval Holdoff) is also disabled.

NOTE

Slower measurements will be encountered with the prescaler option. The option requires each RESOLUTION setting to have a 16-fold longer gate time in Channel C mode, as noted in the specifications.

6331-8. In the 0.1 Hz and 1 Hz RESOLUTION settings, the display may overflow--the OVFL LED will come on and the uppermost digits will be truncated at the left. The digits that are displayed will continue to accurately show the lower-order digits of the measurement.

6331-9. The TRIG/CONT (triggered/continuous) MODE switch on the rear panel of the main counter allows the measurement to be initiated either for signal bursts or for steady-state signals.

6331-10. Continuous Mode Operation

6331-11. Set the rear panel switch to CONT for measuring steady-state signals. Measurements will be taken consecutively, one after another, as long as the input signal is above the squelch threshold (about 3 to 5 mV). Bringing the signal from below to above threshold will reset any measurement in progress and initiate a new measurement sequence. Of course, the RESET Button will also initiate a measurement.

6331-12. Triggered Mode Operation

6331-13. Set the rear panel switch to TRIG for measuring bursts. A measurement will trigger only at the start of a burst--when the peak-envelope of the input signal crosses above the operating threshold. It will make one measurement for each burst. In order to be measured, the burst must be present longer than the gate time (specified by the RESOLUTION setting) plus approximately 2 ms.

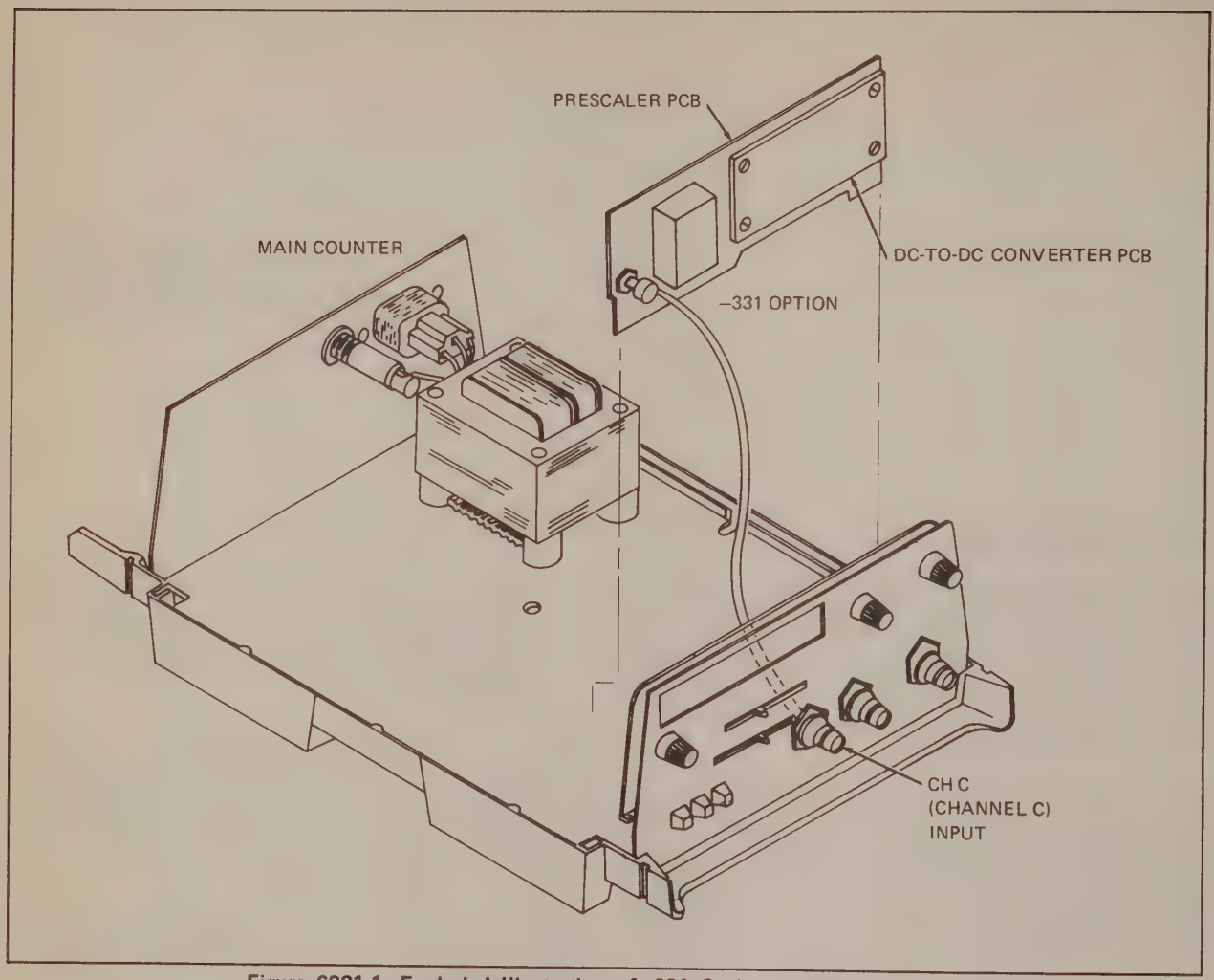


Figure 6331-1. Exploded Illustration of -331 Option and Main Counter

Table 6331-1. Specifications

RANGE:	100 MHz - 1300 MHz
SENSITIVITY:	5 mV rms, up to 600 MHz
	10 mV rms, up to 1000 MHz
	40 mV rms, up to 1300 MHz
IMPUT IMPEDANCE:	50 ohms, nominal
VSWR:	2.5 : 1, typical
MAXIMUM INPUT:	5V rms, fused
GATE TIME:	1.6 ms at 10 kHz resolution
	16 ms at 1 kHz resolution
	160 ms at 100 Hz resolution
	1.6 s at 10 Hz resolution
	16 s at 1 Hz resolution
	160 s at 0.1 Hz resolution
DISPLAY ACCURACY:	±1 count plus time base errors

6331-14. THEORY OF OPERATION

6331-15. Overall Description

6331-16. The main purpose of the -331 prescaler is to scale down the frequency of an input signal to a range acceptable by the main frequency counter. In Figure 6331-2, this operation is accomplished in the two blocks labeled Signal Divider. The effect is that higher frequencies can be measured than would otherwise be possible. The scale factor of the -331 Option is 16--that is, an input signal of 1300 MHz is scaled down to 1300/16 = 81.25 MHz. On board this option is a dc-to-dc converter which produces the –1.8 volt dc supply necessary for the frequency divider chip. A switching regulator is used rather than a linear or resistive regulator to reduce the –12 volts to –1.8 volts, because it provides the efficiency needed.

6331-17. The -331 Prescaler Option performs two other necessary functions: 1) it provides gain, since the option

replaces the front section of your main counter, and 2) it automatically lengthens by 16-fold the time the counter's main gate is open (more about this later).

6331-18. Detailed Description

6331-19. The following descriptions refer to the block diagram, Figure 6331-2, and the detailed schematics of both printed circuit boards that are included in Section 8 of this manual.

6331-20. INPUT AMPLIFIER AND SIGNAL DIVIDERS

6331-21. As shown in the block diagram, Figure 6331-2, the Channel C input signal enters through an input protection fuse, F1. Diode clamping within the hybrid circuit provides further protection from excessive input voltages. A 1300 MHz hybrid amplifier, contained in U3, then amplifies the signal. This hybrid amplifier has four stages which provide approximately 40 dB of overall gain.

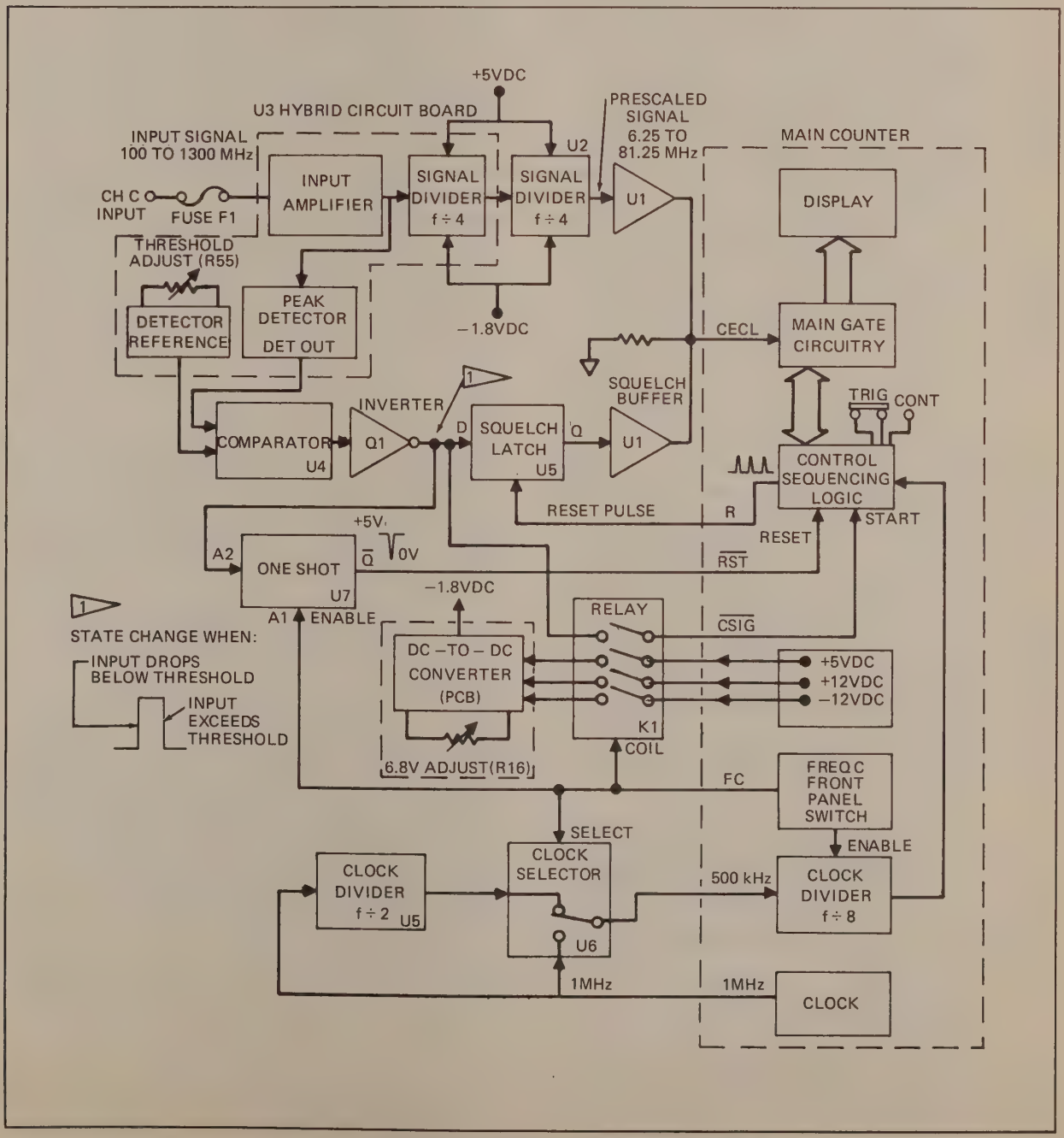


Figure 6331-2. Block Diagram of -331 Prescaler Option

6331-22. The amplifier output feeds both a divide-by-four high frequency divider and a peak detector whose output operates the squelch latch. The divider output is ac-coupled via C1 to the second divide-by-four stage, U2, for a total division of 16. As the block diagram shows, the first divide-by-four integrated circuit (IC) is included on the hybrid circuit U3, and the second is off the hybrid board. The output of U2, the prescaled signal, then passes on to a differential buffer U1 whose output (CECL) enters the main gate of the counter for subsequent accumulation and display.

6331-23. THRESHOLD AND SQUELCH CIRCUIT

6331-24. The peak detector mentioned previously is used in a squelch scheme to prevent the counter from displaying erroneous readings when no signal is applied. (The first divide-by-four is actually a locked oscillator which will free run in the absence of a signal, and be read by the counter if not squelched.) The detector output (DET OUT) is compared to a detector reference (DET REF) by comparator U4. The level of the detector reference determines the squelch threshold, and can be adjusted (Threshold Adjust, R55).

6331-25. The squelch circuit consists of the following chain of blocks shown in Figure 6331-2: peak detector, detector reference, comparator, inverter, squelch latch, and squelch buffer. When the Channel C input signal is low enough to cause the peak detector level to drop below the detector reference, then the comparator output (U4) switches to its negative limit, causing the Q1 output ($\overline{\text{CSIG}}$) to go high, to +5V. This condition at the output of Q1 is then sampled by U5, a D-type flip-flop, when the next reset pulse (R) occurs; this condition is stored at the Q output of U5. A +5V level at this point indicates the signal at the Channel C input is below the level set by the Threshold Adjust. This +5V level drives the squelch buffer U1 output (CECL line) high, which overrides (squelches) the prescaled signal. The output of the two U1 buffers are wired OR. (Emitter-coupled-logic, the device family of the Channel C U1 buffers, gives rise to the mnemonic CECL.)

6331-26. When the input signal rises above the threshold, U4 output goes high, and Q1 output (collector) goes low. At the next reset pulse (R), the squelch latch U5 transfers the low state to its output (Q), and on to the U1 output. This low state permits the prescaled signal to pass on into the main gate.

6331-27. TRIGGERED/CONTINUOUS OPERATION

6331-28. Use the TRIG/CONT switch, located on the rear panel, to switch between discretely triggered and continuously triggered modes. The triggered (TRIG) mode allows frequency measurements to be made of an RF burst, provided the burst remains high for at least the length of the gate pulse (given by the RESOLUTION) plus the 2 ms overhead necessary to initiate the measurement. As explained previously, $\overline{\text{CSIG}}$ goes low as the input signal crosses above the threshold. When the main counter is switched into the triggered (TRIG) mode, the counter will start a measurement in response to the negative-going edge of $\overline{\text{CSIG}}$--that is, when the input signal exceeds the threshold. In the continuous (CONT) mode, a measurment will be initiated not only by $\overline{\text{CSIG}}$, but also by the counter's normal sequencing signal, which indicates the completion of the previous measurement.

6331-29. One-shot U7 is used to generate a master reset pulse, $\overline{\text{RST}}$, for the main instrument every time an input signal crosses from below to above the threshold. This reset pulse is an overriding command which interrupts existing activities, resets the display to zero, and initiates a new measurement sequence, whether in triggered (TRIG) or continuous (CONT) operation. The one-shot is enabled only when the front panel Frequency C function is selected. The purpose of $\overline{\text{RST}}$ is as follows: in case there is a measurement cycle in progress, especially one with a long gate time of 16 or 160 seconds, it immediately re-starts the measurement, rather that letting the counter wait for the cycle to end.

6331-30. CLOCK SCALING

6331-31. Scaling down the input frequency by 16 requires that the gate time be lengthened by 16, in order to realize the same resolution that was obtained without prescaling. For example, a 160 MHz signal counted for 0.1 second will produce 16 million counts. The same input signal when scaled down by 16, to 10 MHz, with the same 0.1 second gate time, would produce only 1 million counts. Thus, to produce 16 million counts the gate must remain open for 1.6 seconds. Resolution is defined in Section 2 of this manual.

6331-32. Lengthening of the main gate time is accomplished by dividing the frequency of the clock which drives the gate circuitry. The clock frequency is divided by 16 to lengthen the main gate time by 16. This division takes place in two stages--each stage is labeled clock divider in Figure 6331-2. A divide-by-two (U5) on the Prescaler PCB, and an additional divide-by-eight in the main instrument. The block labeled clock selector is a NAND/NOR/INVERT gate, U6, which selects the 1 MHz or 500 kHz clock. The decision of when to divide the clock by 16 is provided by the FC (Frequency C) line. Setting the front panel FUNCTION switch to Frequency C forces the FC line high, which routes the clock signal through the divide-by-16 circuitry.

6331-33. CONVERSING POWER

6331-34. Relay K1 disconnects power to this option when it is not in use. The relay closes, connecting power to

this option by setting the front panel FUNCTION switch to Frequency C, which drives FC high, turning on transistor Q2, which activates the relay. Also on board this option is a highly efficient dc-to-dc converter which produces the –1.8 volt supply necessary for the signal dividers.

6331-35. DC-TO-DC CONVERTER

6331-36. The DC-to-DC Converter is designed around a pulse-width modulator (PWM) chip, U1, which is used to regulate the output to –1.8V, the dc supply required by the signal dividers. The circuit is actually designed to supply an output that is 6.8V below the +5V supply. Therefore the +5V and –1.8V supplies present a constant 6.8 volt difference to the signal divider ICs, even when battery powered, and the –5V supply falls from 5.5V to 4.5V as the batteries discharge. This regulation is necessary for the signal dividers to maintain maximum performance during battery operation. The 6.8V regulation is accomplished by referencing the voltage reference VR1 and the feedback resistive divider R15, R16, R17 to +5V.

6331-37. Refer to waveforms shown in the DC-to-DC Converter schematic. The PWM (U1) outputs (at pin 12) a rectangular waveform alternating between +5V and 0V. The period (but not duty cycle) of this signal is determined by R5 and C2. This signal causes both Q1 and Q3 to alternate together between off and on, the collector of Q3 alternating between +0.7V and –12V. The PWM compares the reference voltage at pin 1 to the feedback voltage at pin 2 and adjusts the the duty cycle of Q1 and Q3, until the feedback voltage equals the reference voltage. This balance consequently fixes the output voltage.

6331-38. The inductor-current ramps linearly up and down in response to the alternating +0.7V and –12V at Q3; its average current is equal to the load current. Capacitor C6 filters the ripple on the output. Being a non-dissipating component, L1 helps maintain high efficiency. Transistors Q1 and Q3 switch continually, between saturation and cutoff. Resistor R14 and resistor Q2 form current limiting protection when the current through R14 exceeds approximately 150 mA. When this happens, Q2 forces sensing pin 5 to –12V, which shuts down U1. Resistor R8 and capacitor C7 limit the open-loop gain and provide compensation of the amplifier located inside U1.

6331-39. MAINTENANCE

6331-40. Fuse Replacement

6331-41. The Channel C input to the -331 Option is overvoltage protected by a series fuse F1. The fuse will blow before the input exceeds a level safe for the circuit components, about 10V rms.

NOTE

A spare fuse is located on the circuit board.

6331-42. Figure 6331-3 shows the locations of both the in-circuit fuse and spare fuse. Fuse replacement requires removal of the top cover from the chassis; refer to Disassembly near the beginning of Section 4 of this manual. Be especially careful when following that procedure to prevent damage to the internal circuits. As shown in Figure 6331-3, the in-circuit fuse is located on the circuit board just next to the input cable. It is approximately ¼ inch in height and diameter, and has a clear plastic cap. Unplug the fuse and test for continuity with an ohmmeter. If open, replace it with the spare fuse located elsewhere on the same circuit board. To order another fuse, contact your nearest Fluke Service Center, found listed in Section 7, and order Fluke Part Number 370577 (Littlefuse Part Number 273.200).

6331-43. Performance Test

6331-44. Use the following tests to check the performance and to verify the specifications of the 1300 MHz Prescaler Option.

Set-up Procedure:

1. Table 6331-2 lists the required test equipment. (The step attenuator is necessary because the generator's built-in attenuator produces an increasingly worse signal-to-noise ratio at large attenuations.)

2. Connect your Fluke frequency counter that is to be tested, hereafter called UUT (Unit Under Test), to the above equipment as shown in Figure 6331-4. Disregard the DVM shown in the figure; it is used for the Calibration Adjustment procedures only.

3. Set the controls on the UUT as follows:

   a. Front Panel:

   FUNCTION-----FREQ C
   RESOLUTION---100 Hz

   b. Rear Panel:

   REF switch----------EXT
   TRIG/CONT MODE switch-----CONT

   c. Turn on the power to the UUT, and allow it to warm up for at least 30 minutes.

   d. All other controls may be at any position.

4. Set the Signal Generator to an output level of +10 dBm (707 mV into 50 ohms). Leave the generator output at this level throughout the entire performance test; use the 60 dB Step Attenuator to control the level to the UUT.

6331-45. SENSITIVITY TEST

6331-46. This procedure examines the UUT measurement error at the rated sensitivity at three frequencies:

1. To start with, set the Signal Generator frequency to 100 MHz, and set the Step Attenuator at 43 dB (as listed below). The UUT should measure and display the frequency selected, within ±1 count in the lowest-order digit.

Signal Generator Frequency	Step Attenuator Setting
100 MHz	43 dB (5 mV)
600 MHz	37 dB (10 mV)
1300 MHz	25 dB (40 mV)

2. Repeat the previous step (1) at 600 MHz and 1300 MHz, using the Step Attenuator setting listed for each frequency.

6331-47. THRESHOLD ADJUSTMENT TEST

1. Set the Step Attenuator to 52 dB (UUT input level of 1.8 mV).

2. Set the Signal Generator frequency to 600 MHz. The display should read 0.0000. The display goes to zero to indicate the option is operating at a level below its rated sensitivity. Change the step attenuator setting to 45 dB. The UUT should display 600 MHz.

6331-48. TRIGGERED MODE TEST

1. Set the UUT rear panel TRIG/CONT MODE switch to TRIG.

2. Set the Signal Generator frequency to 800 MHz if not already there; set the Step Attenuator to 53 dB

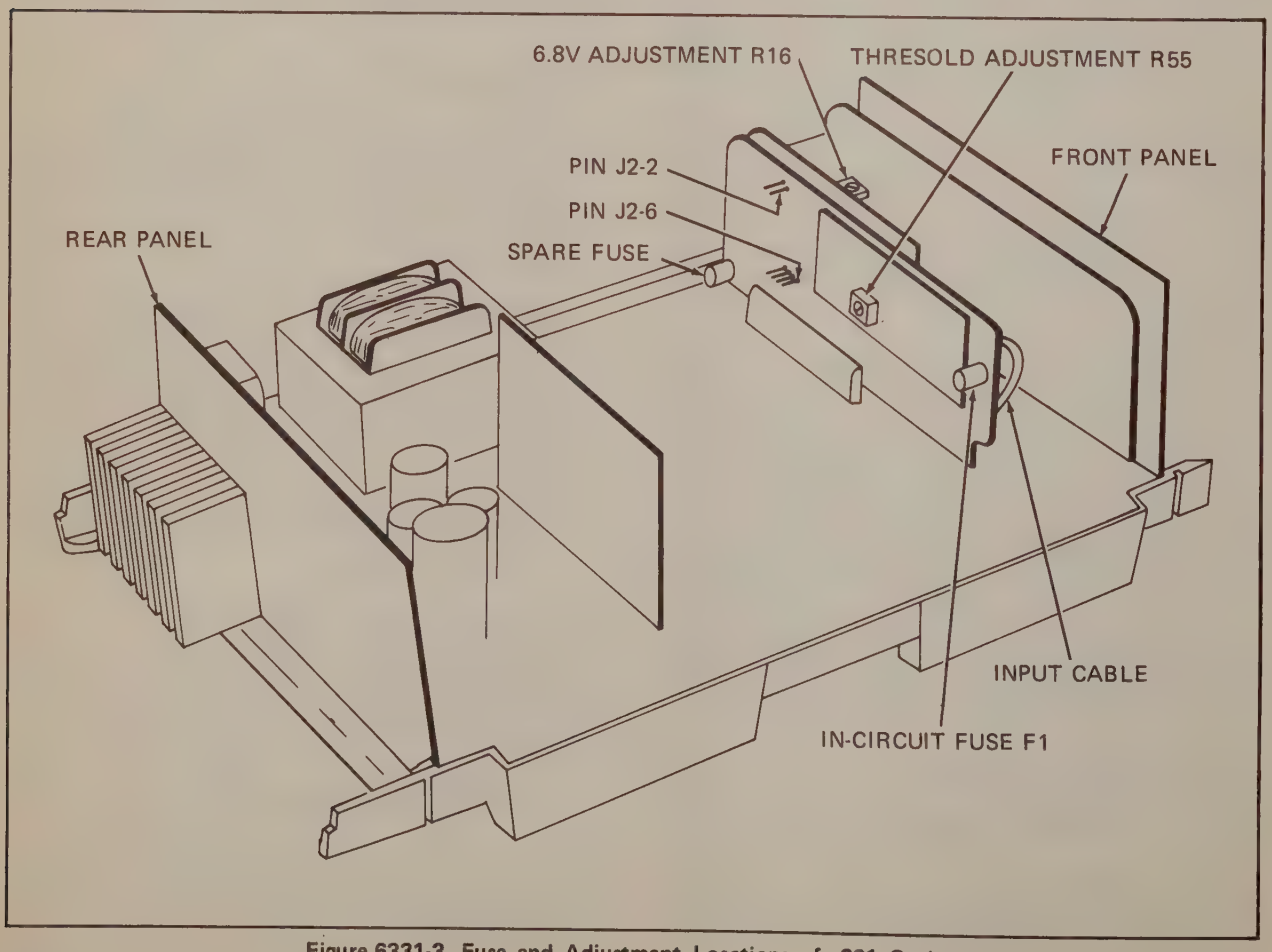


Figure 6331-3. Fuse and Adjustment Locations of -331 Option

(1.6 mV at the UUT input). At this time the counter should not be gating--the gating light should not be flashing.

3. Increase the signal level 16 dB by changing the Step Attenuator setting to 37 dB (10 mV). The counter should gate once and read 800.0000 MHz ±1 count. Using the Signal Generator's 10 MHz reference allows the counter to read this accurately.

6331-49. Calibration Adjustments

6331-50. Calibration adjustments should be performed if the -331 fails the performance test and after repairs are made to the option. The location of all adjustments is shown in Figure 6331-3.

6331-51. Calibration of the -331 Prescaler Option follows a procedure similar to, but more involved than the Performance Test. All the steps of the previous performance test are included in the following calibration adjustment procedure; once you have finished the following procedure you needn't go back and do the performance test.

6331-52. In order to perform calibration adjustments on the -331, you must remove the top cover from the

Table 6331-2. Required Test Equipment

EQUIPMENT TYPE	REQUIRED SPECIFICATIONS	RECOMMENDED TYPE
Synthesized Signal Generator	100 MHz - 1300 MHz, 10 mV	Hewlett-Packard HP8660C
60 dB Step Attenuator	1 dB step with N-female connectors	Weinschel Eng. AD117-69-33
Adapter (1)	N-male to BNC-male	Pomona 4297 (UG1034/U)
Adapters (2)	N-male to BNC-female	Tektronix 103-0045-00 (UG201A/U)
Coax Cable	50 ohm with BNC-male connectors 6" long	RG58A/U
Coax Cable	50 ohm with BNC-male connectors	Fluke Y9111 RG58C/U

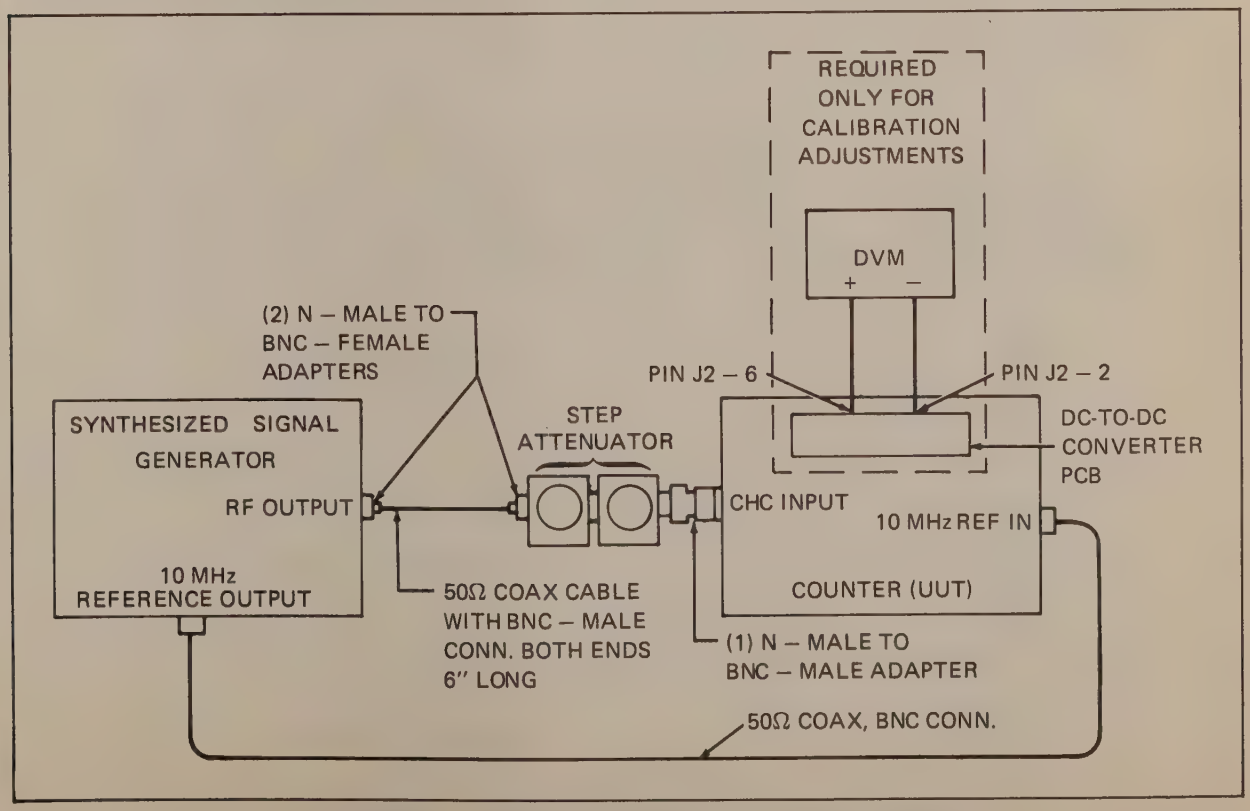

REQUIRED ONLY FOR CALIBRATION ADJUSTMENTS
DVM
+ –
(2) N – MALE TO BNC – FEMALE ADAPTERS
PIN J2 – 6
PIN J2 – 2
SYNTHESIZED SIGNAL GENERATOR
STEP ATTENUATOR
DC-TO-DC CONVERTER PCB
RF OUTPUT
CHC INPUT
10 MHz REF IN
10 MHz REFERENCE OUTPUT
50Ω COAX CABLE WITH BNC – MALE CONN. BOTH ENDS 6" LONG
COUNTER (UUT)
(1) N – MALE TO BNC – MALE ADAPTER
50Ω COAX, BNC CONN.

Figure 6331-4. Equipment Connections for Testing -331 Option

counter under test. It is important for you to follow the steps below in the order given.

6331-53. SET-UP PROCEDURE

1. Remove the top cover as described in the Disassembly procedure in Section 4 of the Fluke counter manual. Follow that procedure very carefully to prevent damage to the internal circuits.

2. Perform all four steps of the Set-up Procedure listed in the Performance Test previously described. In addition to the equipment listed, set up the Digital Voltmeter (DVM) shown in Figure 6331-4.

6331-54. 6.8V SUPPLY DIFFERENCE

6331-55. This procedure adjusts R16 for a DC-to-DC Converter output (−1.8V) that is 6.8 volts below the +5V supply.

1. As illustrated in Figure 6331-4, connect the DVM (+) lead to pin J2-6 of the DC-to-DC Converter PCB, and the DVM (−) lead to pin J2-2.

2. Turn the UUT on and let it warm up for 30 minutes.

3. Adjust R16 for a DVM reading between 6.78 and 6.82 volts, if it is outside this range.

4. Disconnect the DVM.

6331-56. VERIFY THE UUT SENSITIVITY (WITH THRESHOLD OFF)

1. Find R55, the Threshold Adjust trimpot, located as shown in Figure 6331-3. Turn R55 fully counterclockwise (when looking at the trimpot); this turns the threshold off. Now that the threshold is off, the UUT will continue to display readings, even with no input.

2. Set the Signal Generator to 100 MHz, +10 dBm.

3. Set the Step Attenuator to 30 dB to produce a 22.4 mV level to the UUT. The UUT should now be gating (the GATE light flashing), and the display should read 100.0000 MHz plus or minus 1 count in the lowest-order digit.

4. Increase the attenuation (decrease the level) in 1 dB steps until the display has more than ±1 count error. Back off 1 dB (that is, to within ±1 count) and record the attenuator setting. The UUT sensitivity is within specifications if the Step Attenuator reads greater than what is listed in Table 6331-3 for the frequency tested.

5. Repeat the previous step at every multiple of 100 MHz, using the acceptance data listed in Table 6331-3.

Table 6331-3. Calibration Sensitivity

SIGNAL GENERATOR FREQUENCY MHz	SENSITIVITY ACCEPTABLE IF STEP ATTENUATOR SETTING IS GREATER THAN:
100 200 300 400 500	43 dB (less than 5 mV)
600 700 800 900 1000	37 dB (less than 10 mV)
1100 1200 1300	25 dB (less than 40 mV)

6331-57. THRESHOLD ADJUSTMENT

6331-58. The Threshold Adjust trimpot (R55) determines the input level below which the counter stops taking measurements, and instead displays zero.

1. Set the Step Attenuator to 49 dB (UUT input level of 2.5 mV); set the Generator Frequency at 600 MHz.

2. Rotate the Threshold Adjust trimpot (R55), located in Figure 6331-3, to the point where the display drops to a 0.0000 reading. The threshold is now properly adjusted.

6331-59. TEST THE TRIG MODE

6331-60. This is only a test and has no adjustment associated with it.

1. Set the UUT rear panel TRIG/CONT MODE switch to TRIG.

2. Set the Signal Generator frequency to 800 MHz if not already there. Set the Step Attenuator to 53 dB (1.6 mV at the UUT input).

3. At this time the counter should not be gating--the gating light should be off. Change the Step Attenuator setting to 37 dB (10 mV). The counter should gate once and read 800.0000 MHz ±1 count if the trigger circuit works properly.

6331-61. LIST OF REPLACEABLE PARTS

6331-62. A list of replaceable parts for the 72XXA-331 Option is given in Table 6331-4, 6331-5, and 6331-6. Refer to Section 5 of this manual for ordering information.

6331-63. There are two printed circuit boards in the -331 Option. They are shown together in the Final Assembly Figure 6331-5, as well as separately, in Figures 6331-6 and 6331-7.

Table 6331-4. Final Assembly, 1300MHz Prescaler

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
	FINAL ASSEMBLY, 1300 MHZ PRESCALER FIGURE 6331-5 (72XXA-331K)	ORDER	BY	OPTION 72XXA-331K			
A1	1300 MHZ PRESCALER PCB ASSEMBLY	475913	89536	475913	1		
A2	DC TO DC CONVERTER PCB ASSEMBLY	475889	89536	475889	1		
H1	LOCKWASHER, #6	110338	89536	110338	4		
H2	SCREW, PHP, 6-32 X 1/4	152140	89536	152140	4		
KIT	RECOMMENDED SPARE PARTS KIT (72XXA-331)	541490	89536	541490	AR		
TM1	INSTRUCTION SHEET 72XXA-331K (NOT SHOWN)	546087	89536	546087	1		*
W1	COAX CABLE ASSEMBLY	521724	89536	521724	1		

* FOR KIT INSTALLATION

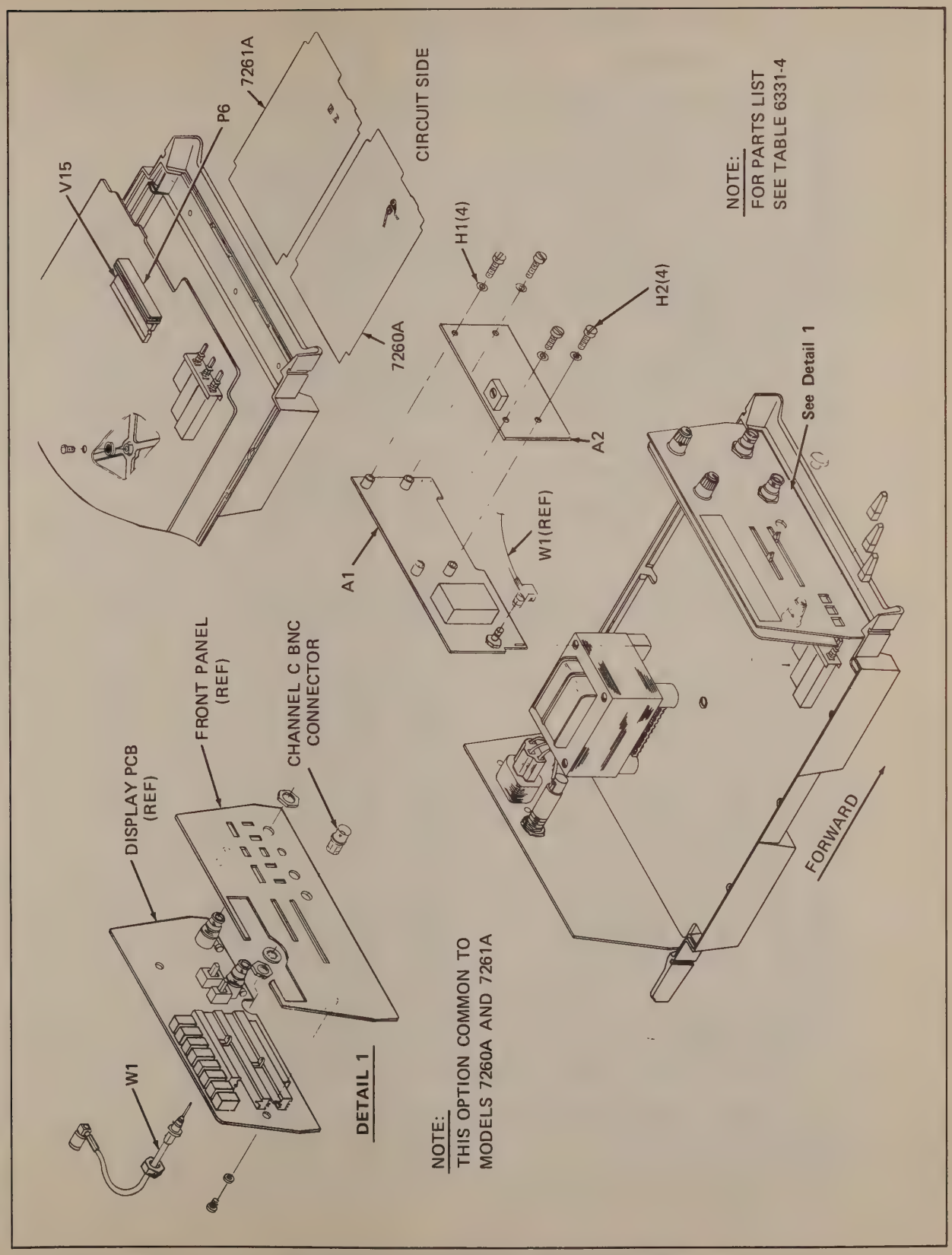


Figure 6331-5. Final Assembly, 1300 MHz Prescaler

Table 6331-5. 1300MHz Prescaler PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG. PART NO.	TOT QTY	REC QTY	NOTE
A1	1300 MHZ PRESCALER PCB ASSEMBLY FIGURE 6331-6 (7260A-4004T)	475913	89536	475913	REF		
C1	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	5		
C2	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	6		
C3	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C4	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C5	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C6	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C7	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C8	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C9	CAP, CER, .001 UF +/-20%, 500V	402966	72982	8121-A100-W5R-102M	2		
C10	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C11	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C12	CAP, CER, .001 UF +/-20%, 500V	402966	72982	8121-A100-W5R-102M	REF		
C13	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
CR1	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	2		
CR2	DIODE, GE, 80 MA, 100 PIV	149187	93332	1N270	1		
CR3	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
F1	FUSE, 1/5 AMP (AND 1 SPARE)	370577	75915	273.200	2	5	
H1	SPACER (NOT SHOWN)	446351	89536	44631	4		
J1	SOCKET, BNC CONNECTOR	352450	98291	51-051-0000	1		
J2	CONNECTOR, POST (NOT SHOWN)	267633	00779	86144-1	6		
K1	RELAY, DRY REED	494732	21317	E54AX5	1		
L1	CHOKE, 6-TURN	320911	89536	320911	2		
L2	CHOKE, 6-TURN	320911	89536	320911	REF		
P3	CONNECTOR, RECEPTACLE	375329	00779	85863-3	2		
P4	CONNECTOR, RECEPTACLE	375329	00779	85863-3	REF		
Q1	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q2	XSTR, SI, NPN	381798	04713	MPSA-13	1	1	
R1	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	3		
R2	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R7	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R8	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	2		
R9	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
R10	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	2		
R12	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R13	RES, DEP. CAR, 47K +/-5%, 1/4W	348896	80031	CR251-4-5P47K	1		
R14	RES, DEP. CAR, 220K +/-1%, 1/4W	348953	80031	CR251-4-5P220K	1		
R15	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	REF		
U1	IC, TRIPLE LINE RECEIVER, 16-PIN DIP	369702	18324	N10116B	1	1	
U2	IC, ECL, 1600 SERIES, GHZ PRESCALER	472787	04713	MC1697P	1	1	
U3	IC, HYBRID, 1300 MHZ	490664	89536	490664	1	1	
U4	IC, LIN, OP-AMP, LO BIAS CURRENT	413732	12040	LM308N	1	1	
U5	IC, TTL, DUAL, "D" TYPE CLEAR AND PRESET	393124	01295	SN74L574N	1	1	
U6	IC, TTL, QUAD, 2-INPUT, POS, NAND GATE	393033	01295	SN74LS00N	1	1	
U7	IC, MONOSTABLE, MULTIVIBRATOR	293050	01295	SN74121N	1	1	
XF1	SOCKET, FUSE	403642	00779	50863-8	4		
XU3	SOCKET, IC, (U3)	376418	22526	75060-007	23		
Z1	RESISTOR NETWORK, 510 +/-2%, 1/8W	459974	89536	459974	1		

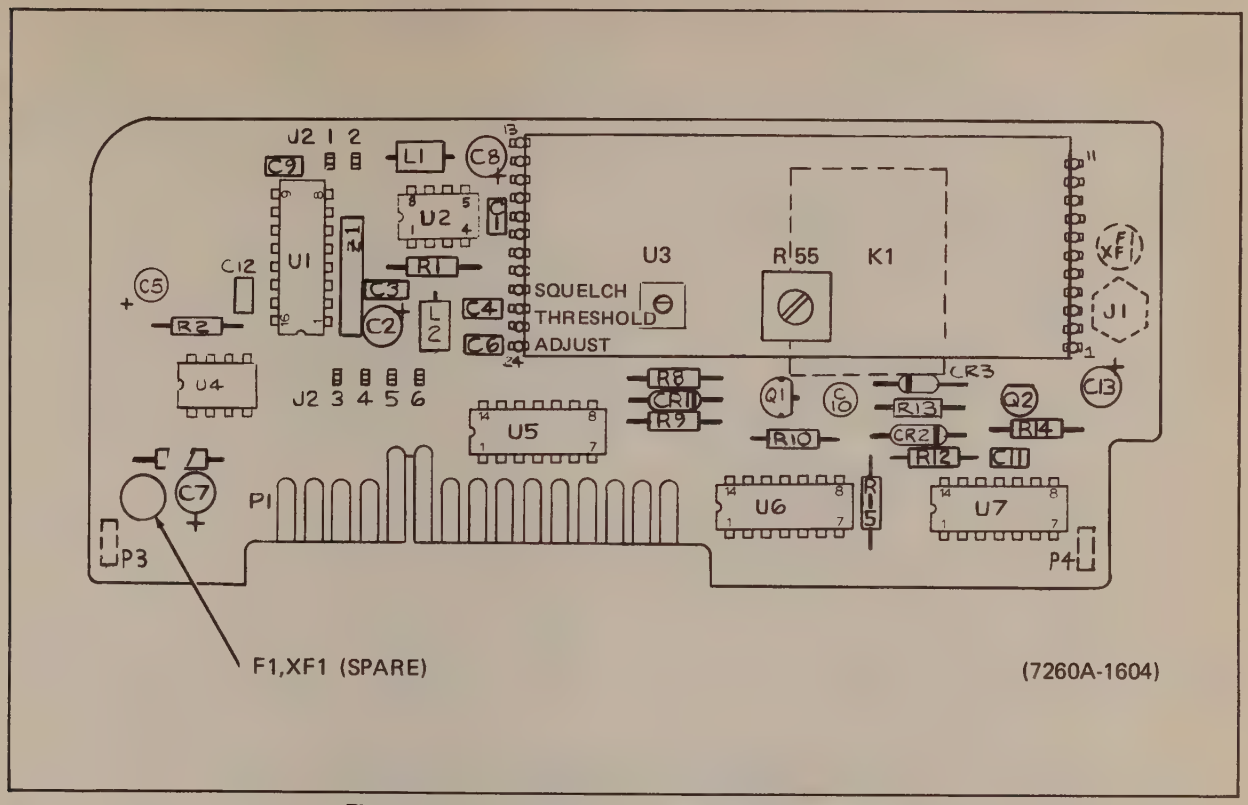
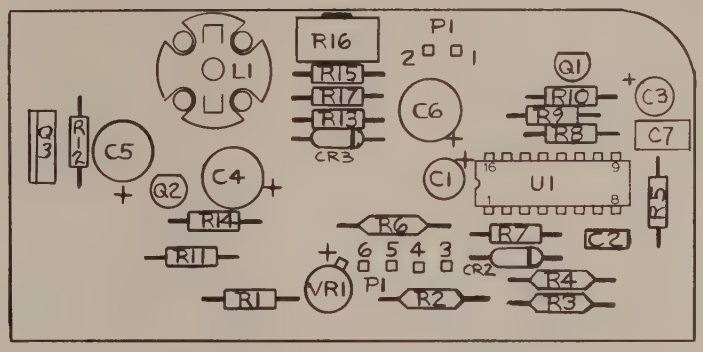


Figure 6331-6. A1 1300 MHz Prescaler PCB Assembly

Table 6331-6. DC-to-DC Converter PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A2	DC-TO-DC CONVERTER PCB ASSEMBLY FIGURE 6331-7 (7260A-4005T)	475889	89536	475889	REF		
C1	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	2		
C2	CAP, CER, 1000 PF +/-20%, 500V	402966	32897	8121-A100-W5R-102M	1		
C3	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C4	CAP, TA, 150 UF +/-20%, 20V	422576	56289	196D157X0020TA1	1		
C5	CAP, TA, 150 UF +/-20%, 20V	422576	56289	196D157X0020TA1	REF		
C6	CAP, TA, 220 UF +/-20%, 6V	408682	56289	196D227X0006TE4	1		
C7	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	1		
CR2	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	1		
CR3	RECTIFIER, SI, FAST RECOVERY, 100V	495739	14099	3FF10	1		
L1	INDUCTOR	521500	89536	521500	1		
MP1	INSULATOR, XSTR, (TO VR1) (NOT SHOWN)	175125	07047	10172-DAP	1		
P1	CONNECTOR, RECEPTACLE	267476	00779	85861-2	6		
Q1	XSTR, SI, PNP	195974	04713	2N3906	1		
Q2	XSTR, SI, NPN	218396	04713	2N3904	1		
Q3	XSTR, SI, NPN	325761	09214	D44C5	1		
R1	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	2		
R2	RES, MTL. FILM, 130K +/-1%, 1/8W	221648	91637	MFF1-81303F	2		
R3	RES, MTL. FILM, 249K +/-1%, 1/8W	268805	91637	CMF552493F	2		
R4	RES, MTL. FILM, 249K +/-1%, 1/8W	268805	91637	CMF552493F	REF		
R5	RES, DEP. CAR, 12K +/-5%, 1/4W	348847	80031	CR251-4-5P12K	1		
R6	RES, MTL. FILM, 130K +/-1%, 1/8W	221648	91637	MFF1-81303F	REF		
R7	RES, DEP. CAR, 1.5K +/-5%, 1/4W	343418	80031	CR251-4-5P1K5	1		
R8	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
R9	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	2		
R10	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	REF		
R11	RES, DEP. CAR, 3.9K +/-5%, 1/4W	342600	80031	CR251-4-5P3K9	1		
R12	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R13	RES, DEP. CAR, 1.8K +/-5%, 1/4W	441444	80031	CR251-4-5P1K8	1		
R14	RES, DEP. CAR, 4.7 +/-2%, 1/4W	342683	80031	CR251-2-5P4.7E	1		
R15	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-4-5P5K6	1		
R16	RES, VAR, CERMET, 200 +/-10%, 1/2W	285148	11236	360S206A	1		
R17	RES, DEP. CAR, 1.1K +/-5%, 1/4W	348797	80031	CR251-4-5P1K1	1		
U1	IC, LIN, REG PULSE WIDTH MODULATOR	454678	01295	SG3524N	1		
VR1	IC, LIN, LOW VOLTAGE REFERENCE 1.22V	452771	89536	452771	1		



(7260A-1605)

Figure 6331-7. DC-to-DC Converter PCB Assembly

Option -521
Printer Interface

521-1. INTRODUCTION

521-2. The purpose of the Printer Interface is to allow a Fluke counter (7220A, 7250A, 7260A, or 7261A) to be connected to a Fluke printer (2020A, 2021A, or 2030A) for printed output of counter measurements. The Printer Interface consists of the 72XXA-521 Digital Interface PCB, which is factory-installed in the counter.

NOTE

The 72XXA-521 Digital Interface PCB is also used in the IEEE Interface system for the counters. For information about its function in the IEEE Interface, refer to the 72XXA-521/-522 IEEE Interface.

521-3. The 2020A or 2021A printers must have Printer Optioin -004 installed. The 2030A is ready for connection without any additional options. The counter and printer are connected by an accessory cable. The cable is available in either a 2 foot (Y7203), or 5 foot (Y7204) length.

521-4. Data is transferred from the counter to the printer in a bit-parallel, character-serial manner. The printout from the printer includes the measurement reading of the counter and the measurement unit.

521-5. OPERATING INSTRUCTIONS

521-6. Preparation

521-7. To prepare the instruments for printing measurements, follow these steps:

1. Connect the counter and printer together via cable Y7203 or Y7204. Cable connections are made at the rear panel of each instrument.

2. Apply power to each instrument.

3. Apply a valid input signal to the counter, and set the controls as desired.

4. Set the printer controls as desired. If necessary, refer to the printer manual for operating instructions.

521-8. Printing Measurements

521-9. Figure 521-1 shows three examples of measurement printouts made by a 2030A printer. Notice in all 3 examples that all counter digits are printed (either 8 or 9, depending on the counter) including any leading zeros. Notice also in the first example that 8 digits are printed for the 7250A. The 7250A has a 7 digit display, but it supplies 8 digits of valid information to the printer.

521-10. The numbers 2 and 3 in the column at the far left are non-selectable instrument addresses which have been preassigned at the factory in conformance with a printer addressing feature. All the counters have been assigned address 2 except the 7220A, which has been assigned address 3. The 7220A has a unique address because its measurement capacity is one digit greater than the other counters.

521-11. The addresses correspond to a jumper pin on the Digital Interface PCB in the counter. If the printer does not print measurement data correctly, or if it does not print at all, the jumper may be in the wrong position. To check the position or move the jumper, refer to the following paragraph.

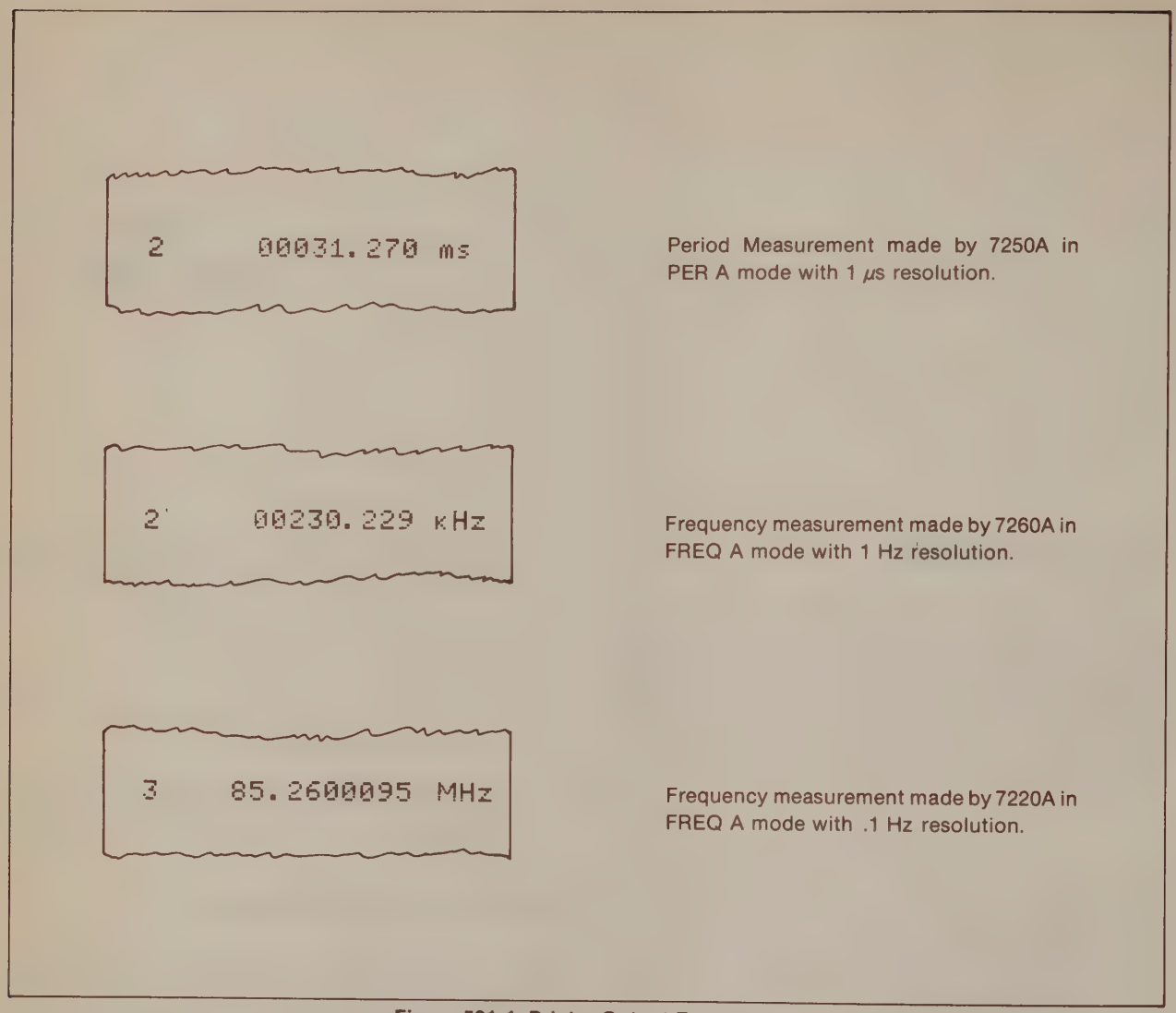

2 00031.270 ms
Period Measurement made by 7250A in PER A mode with 1 μs resolution.
2 00230.229 kHz
Frequency measurement made by 7260A in FREQ A mode with 1 Hz resolution.
3 85.2600095 MHz
Frequency measurement made by 7220A in FREQ A mode with .1 Hz resolution.

Figure 521-1. Printer Output Examples.

521-12. Moving the Address Jumper

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS YOU ARE QUALIFIED TO DO SO.

521-13. To examine the address jumper, disconnect the counter power cord and remove the top cover of the counter. Be careful not to separate the front and rear panels from the bottom case half. Locate the jumper on the upper left corner of the component side of the Digital Interface PCB. Refer to the table in Figure 521-2, and examine the jumper to determine the address selected. If the proper address is not selected, remove the jumper pin by pulling it straight out. Refer to the table in Figure 521-2 and determine the proper wiper and slot location (the jumper slot numbers are also printed on the back of the PCB). Firmly insert the jumper into place.

521-14. Operating Notes

521-15. In the single print mode, the printer prints the first counter reading it receives and then stops. In the continuous print mode, the printer prints out counter readings as it receives them, up to a maximum rate of 3 readings per second. When the measurement cycle rate of the counter is greater than 3 per second (such as frequency measurements made with 100 Hz resolution), then not all counter readings will be printed out. The printer also will not print out readings made in the Totalize mode by the 7250A, 7260A, or 7261A.

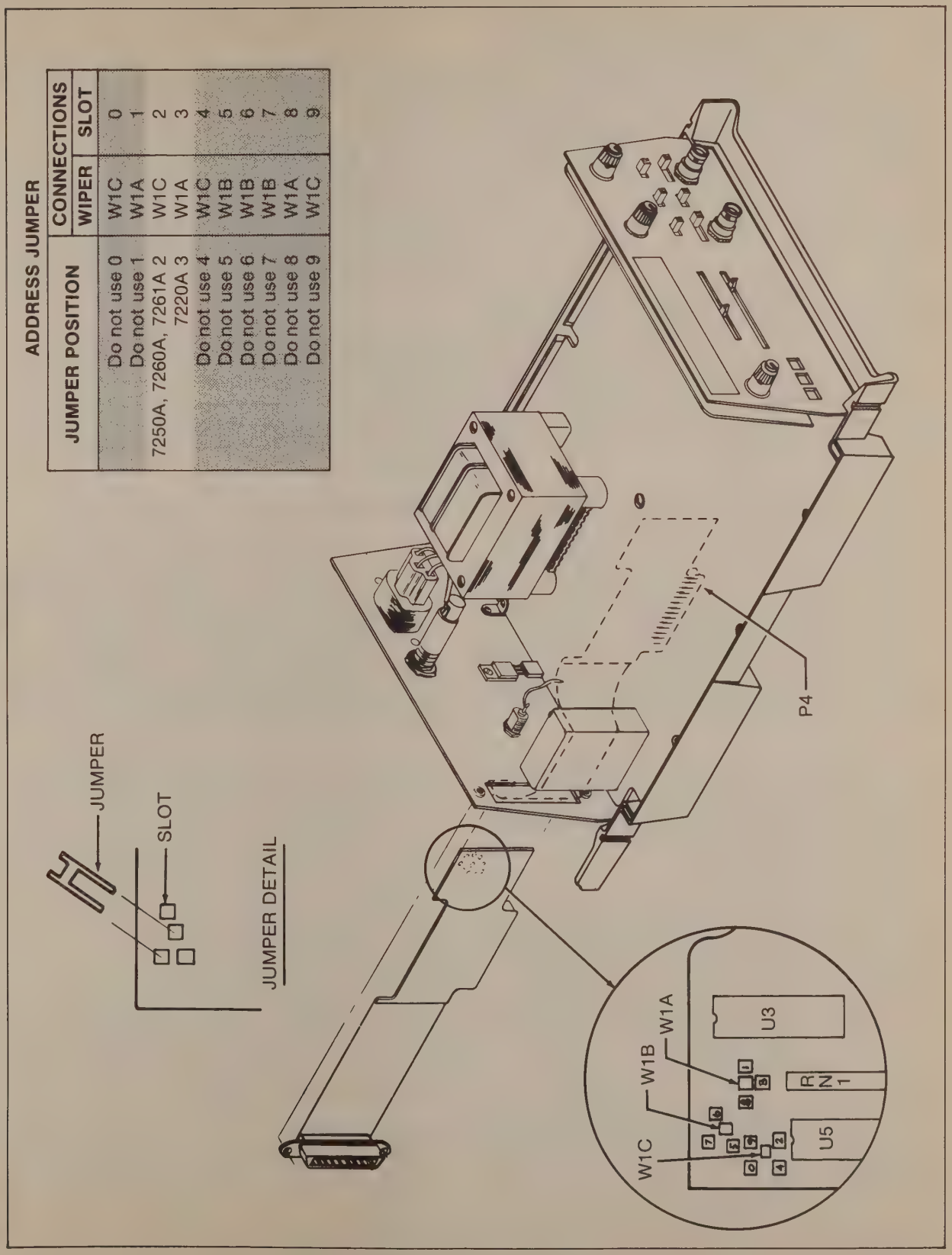


Figure 521-2 Address Jumper

521-16. It is important to note that the printer gives no indication when an overflow condition exists in the counter. The printer will print whatever digits are present on the display at the end of the reading, whether the counter display has overflowed or not. The one exception to this is the 7250A, which supplies eight digits of valid information to the printer before overflowing, even though it has a seven digit display.

521-17. THEORY OF OPERATION

521-18. Overview

521-19. An overview of the operation of the Printer Interface is presented at the top of Figure 521-3. As shown in the figure, the printer functions primarily as a passive listener which receives and prints counter readings without affecting the operation of the counter. The printer does have a limited talk function, however. It must first send an address to the Printer Interface and have the address acknowledged by the Interface before data can be transferred from the counter.

521-20. An expanded view of the interface operation is shown in the large box at the bottom of Figure 521-3. Data transfer is controlled by the control logic, which receives address input from the printer, and three inputs from the counter, OSC, DS1, and BUSY. OSC is the oscillator signal from the scan oscillator that controls the timing of the internal strobing and mutiplexing of the counter. DS1 is the first Digit Strobe (LSD) of the counter, and BUSY is a signal from the control logic of the counter which indicates that a measurement cycle is in progress.

521-21. The Interface Control Logic has three outputs. One output enables the Data Buffer, and the other two are the control lines $\overline{\text{DATVAL}}$ and $\overline{\text{ADRVAL}}$ that are sent to the printer to enable data transfer.

521-22. Detailed Description

521-23. The following paragraphs discuss the sequence of events that take place before, during, and after data transfer. Refer to the block diagram at the bottom of Figure 521-3. The timing can be seen at the top of Figures 521-4 and 521-5, and the circuits are shown in detail in the schematic in Section 8 of the counter Instruction Manual.

521-24. ADDRESS DECODING

521-25. Data Transfer is initiated by the printer. The printer places a 4 bit BCD address on lines A0, A1, A2 and A3. The BCD address is converted to decimal, and if the address corresponds to the address selected by the address jumper, a high signal passes on to the Control Logic. This signal then enables the Data Buffer, and is also inverted and returned to the printer as a low $\overline{\text{ADRVAL}}$.

521-26. DATA TRANSFER

521-27 The low $\overline{\text{ADRVAL}}$ is sent to the microcomputer of the printer and indicates that the Printer Interface has received the address and the counter is preparing to transfer data. After the counter takes a reading, BUSY goes low, then high, which tells the Interface Control Logic a reading has been completed. The next DS1 digit strobe enables the $\overline{\text{DATVAL}}$ line, which is the inverted OSC signal. The digits of the information are now transferred in the sequence indicated in Figures 521-4 and 521-5. The 7220A is shown in a separate figure because it is a nine-digit counter, and nine digits of information are passed instead of eight.

521-28. The timing of the data transfer is controlled by the $\overline{\text{DATVAL}}$ pulses. One $\overline{\text{DATVAL}}$ pulse occurs for each digit of information transferred. All the counters have eight $\overline{\text{DATVAL}}$ pulses except the 7220A, which has nine for its nine digits. The second DS1 digit strobe disables the $\overline{\text{DATVAL}}$ pulses, thus ending the data transfer.

521-29. Data Format

521-30. The format for the data transfer is shown in Figures 521-4 and 521-5. The digits are transferred in the sequence shown, beginning with the LSD, then the MSD, and continuing in descending order of significance. Note that the 7250A provides eight digits of information to the printer even though the 7250A has a seven digit display. The MSD in Figure 521-5 is not displayed on the 7250A, but is printed by the printer. The seven digits displayed on the 7250A are 2SD-LSD.

521-31. There are six lines on which measurement data passes from the counter to the printer. Four of the lines (B1, B2, B4 and B8) transfer the measurement reading in BCD. The DP and UX lines are used to indicate when to insert the decimal point and the type of measurement unit.Table 521-1 shows an example of the format for the transmission of measurement data from a 7250A.

521-32. MAINTENANCE

521-33. Troubleshooting

521-34. If the printer does not print measurment data correctly, or if it does not print at all, first check the position of the address jumper on the Digital Interface PCB. Refer to the section on Moving the Address Jumper in the Operating Instructions.

521-35. If the printer still does not print data correctly, make sure the printer and counter are properly connected with cable Y7203 or Y7204. Apply power to the instruments, select desired settings, and apply a valid input signal to the counter. A non-burst mode must be selected for a 7220A. Use an oscilloscope and complete the procedure given in Table 521-2.

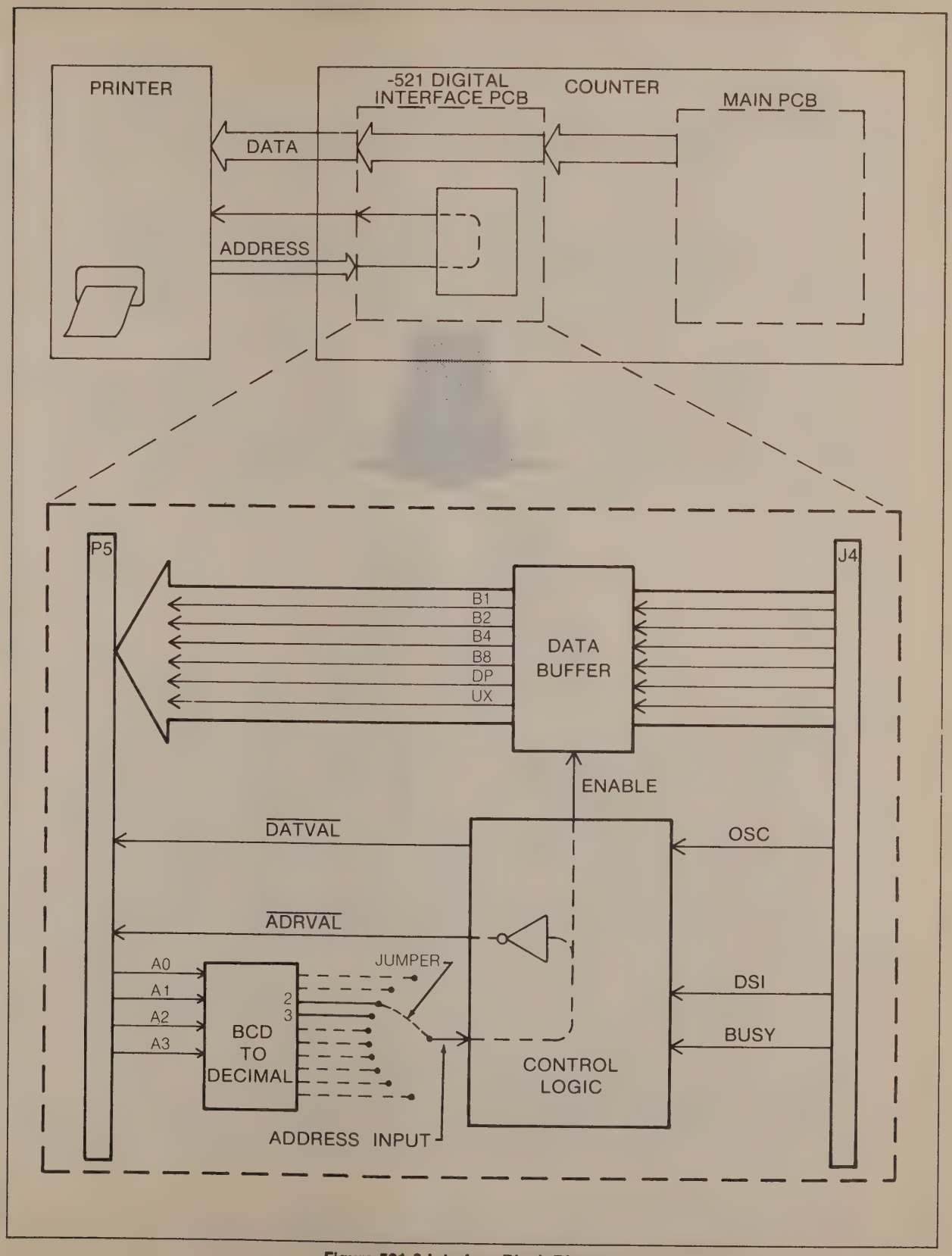
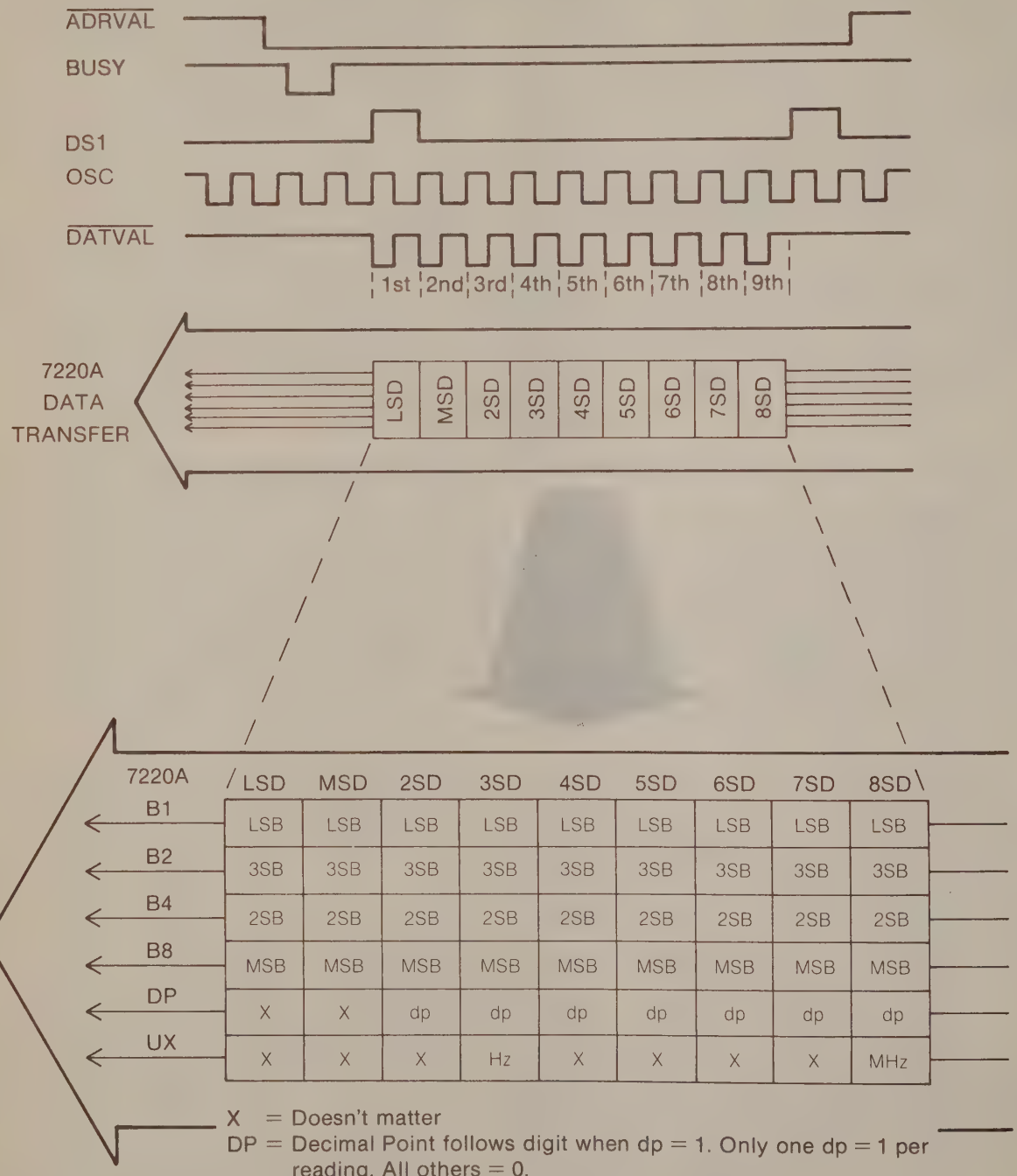


Figure 521-3 Interface Block Diagram


ADRVAL
BUSY
DS1
OSC
DATVAL
1st 2nd 3rd 4th 5th 6th 7th 8th 9th
7220A DATA TRANSFER
LSD MSD 2SD 3SD 4SD 5SD 6SD 7SD 8SD
7220A
B1
B2
B4
B8
DP
UX
LSD MSD 2SD 3SD 4SD 5SD 6SD 7SD 8SD
LSB LSB LSB LSB LSB LSB LSB LSB LSB
3SB 3SB 3SB 3SB 3SB 3SB 3SB 3SB 3SB
2SB 2SB 2SB 2SB 2SB 2SB 2SB 2SB 2SB
MSB MSB MSB MSB MSB MSB MSB MSB MSB
X X dp dp dp dp dp dp dp
X X X Hz X X X X MHz

X = Doesn't matter
DP = Decimal Point follows digit when dp = 1. Only one dp = 1 per reading. All others = 0.
UX = Measurement unit occurs as indicated when bit = 1. Only one UX bit = 1 per reading. All others = 0 or are ignored.

Figure 521-4. 7220A Data Transfer Format and Timing

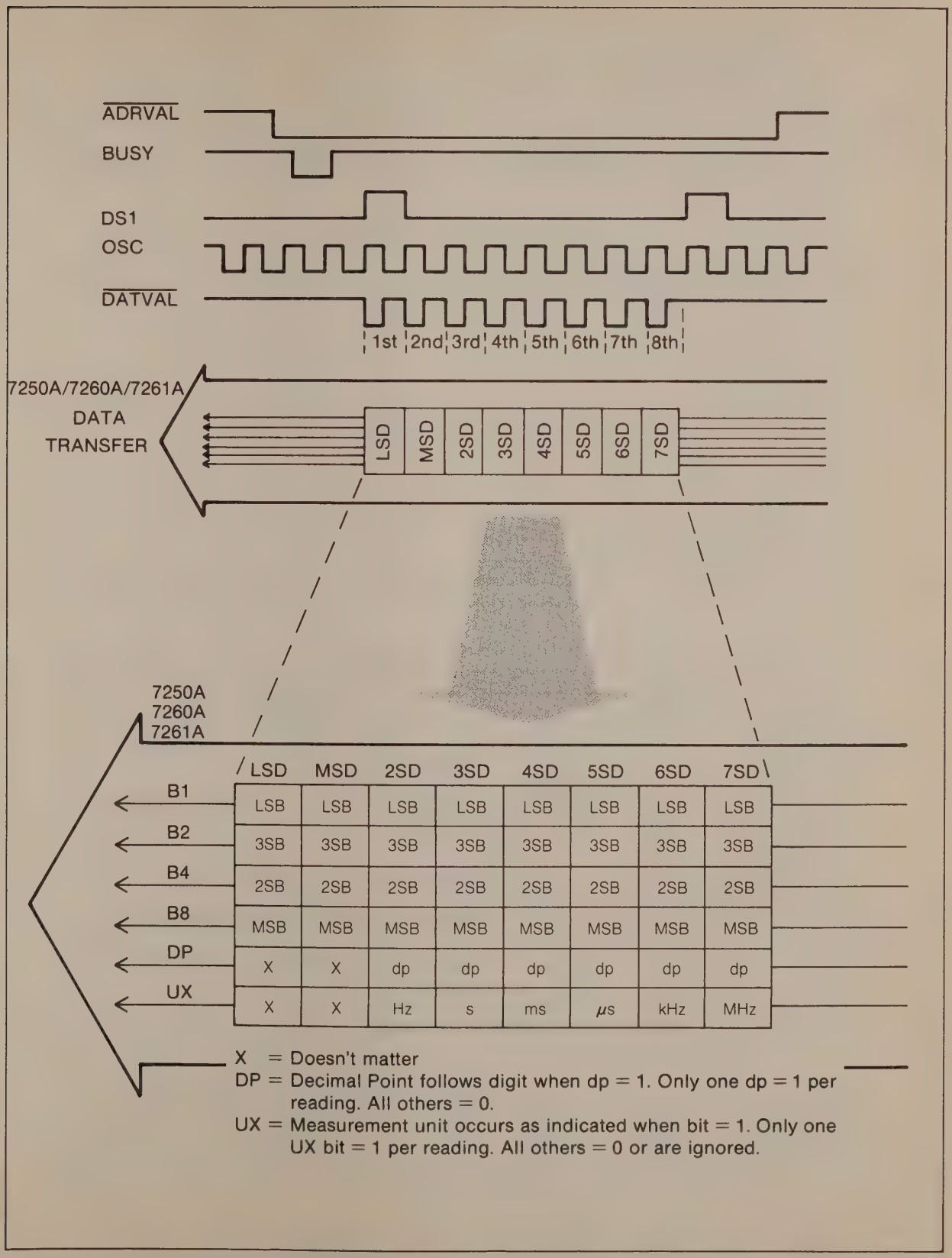

ADRVAL
BUSY
DS1
OSC
DATVAL
1st 2nd 3rd 4th 5th 6th 7th 8th
7250A/7260A/7261A
DATA
TRANSFER
LSD MSD 2SD 3SD 4SD 5SD 6SD 7SD
7250A
7260A
7261A
LSD MSD 2SD 3SD 4SD 5SD 6SD 7SD
B1 LSB LSB LSB LSB LSB LSB LSB LSB
B2 3SB 3SB 3SB 3SB 3SB 3SB 3SB 3SB
B4 2SB 2SB 2SB 2SB 2SB 2SB 2SB 2SB
B8 MSB MSB MSB MSB MSB MSB MSB MSB
DP X X dp dp dp dp dp dp
UX X X Hz s ms μs kHz MHz
X = Doesn't matter
DP = Decimal Point follows digit when dp = 1. Only one dp = 1 per reading. All others = 0.
UX = Measurement unit occurs as indicated when bit = 1. Only one UX bit = 1 per reading. All others = 0 or are ignored.

Figure 521-5. 7260A, 7261A, 7250A Data Transfer Format and Timing

Table 521-1. Data Format Example

7250A frequency measurement of 537.387 kHz made in the FREQ A mode with 1 Hz resolution.

	LSD	MSD	2SD	3SD	4SD	5SD	6SD	7SD
B1	1	0	0	1	1	1	1	0
B2	1	0	0	0	1	1	1	0
B4	1	0	0	1	0	1	0	0
B8	0	0	0	0	0	0	0	1
DP	x	x	0	0	0	1	0	0
UX	x	x	0	0	0	0	1	0

x=Doesn't matter

The printer output looks like this:

```
2      00537.387 kHz
```

Table 521-2. Troubleshooting Guide-Printer Interface

CHECK:		YOU SHOULD SEE:
Connector J4	Pin 2	+5V (supplied by counter)
Address Decode	U2-5	Positive pulse (CMOS) each time the printer addresses the counter.
U1 Buffer Enable	U3-4	Negative pulse, inverse of pulse on U2-5.
BUSY (BY)	U2-3	Pulses from counter indicating measurement is complete.
	U2-1	Positive pulse, one per print command. Occurs at completion of measurement.
	U2-11	Positive pulses, DSI from display.
	U2-13	Positive pulse, one per print command. Goes high at beginning of DSI, falls at beginning of next DSI.
$\overline{\text{DATVAL}}$	U4-11	Burst of 8 negative pulses (9 for the 7220A), one burst per print command.

521-36. Pin Assignment Table

521-37. Table 521-3 provides a list of the pin assignments for P5, which is the connection at the rear panel of the counter between the Digital Interface PCB and the cable to the printer. For pin assignments for J4, the connection between the Digital Interface PCB and the Main PCB of the counter, see the schematic in Section 8 of the Counter Instruction Manual.

521-38. REPLACEABLE PARTS

521-39. A detailed list of replaceable parts is presented in Table 521-4. Figure 521-6 can be used as an aid in locating components. Refer to Section 5 of the counter instruction manual for parts ordering information.

Table 521-3. P5 Pin Assignments.

P5 PIN NO.	MNEMONIC	SOURCE		DESCRIPTION
		COUNTER	PRINTER	
1	$\overline{\text{ADRVAL}}$	X		Address Valid
2	$\overline{\text{DATVAL}}$	X		Data Valid
3	A0		X	LSB (Counter Address)
4	A1		X	3SB (Counter Address)
5	A2		X	2SB (Counter Address)
6	A3		X	MSB (Counter Address)
7	not used			
8	not used			
9	D0	X		BCD Bit 1
10	D1	X		BCD Bit 2
11	D2	X		BCD Bit 4
12	D3	X		BCD Bit 8
13	D4	X		Decimal Point (DP)
14	D5	X		Measurement Unit (UX)
15	not used			
16	not used			
17	GND			
18	+5V Supplied by printer			
19-36	not used			

Note: $\overline{\text{BUSEN}}$ (pin no. 22) is always held high when the Printer Interface is used with a printer.

Table 521-4. Digital Interface (Option -521)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
	⊘ DIGITAL INTERFACE, OPTION-521 FIGURE 6521-6 (7220A-4007T)	ORDER	BY	OPTION -521	1		
J4	CONNECTOR, 36-PIN	484733	00779	87406-1	1		
P5	CONNECTOR, 36-PIN	479493	00779	552817-1	1		
RN1	RESISTOR NETWORK, 100K	461038	89536	461038	1	1	
U1⊘	IC, C-MOS, HEX NON INVET BUFFERS	407759	04713	MC14503CP	3	1	
U2⊘	IC, C-MOS, DUAL TYPE "D" FLIP-FLOP	340117	04713	MC14013CP	1	1	
U3⊘	IC, C-MOS, QUAD, 2-INPUT NAND GATES	355198	04713	MC14011CP	1	1	
U4	IC, TRI-STATE HEX BUFFER	483800	01295	SN74LS367N	1	1	
U5⊘	IC, C-MOS, BCD TO DECIMAL DECODER	380741	01295	TP4028AN	1	1	
U6	IC, LO-PWR, SCHOTTKY TRI-ST OCTAL, BFR.	429902	12040	DM81LS95N	1	1	
U7⊘	IC, C-MOS, HEX NON INVET BUFFERS	407759	04713	MC14503CP	REF		
U8⊘	IC, C-MOS, HEX NON INVET BUFFERS	407759	04713	MC14503CP	REF		
W1	PLUG, JUMPER	416842	91506	8136-651P2	1		
W1.	SOCKETS	376418	89536	376418	13		

NOTE: ⊘ Indicates the item can be damaged by static discharge.

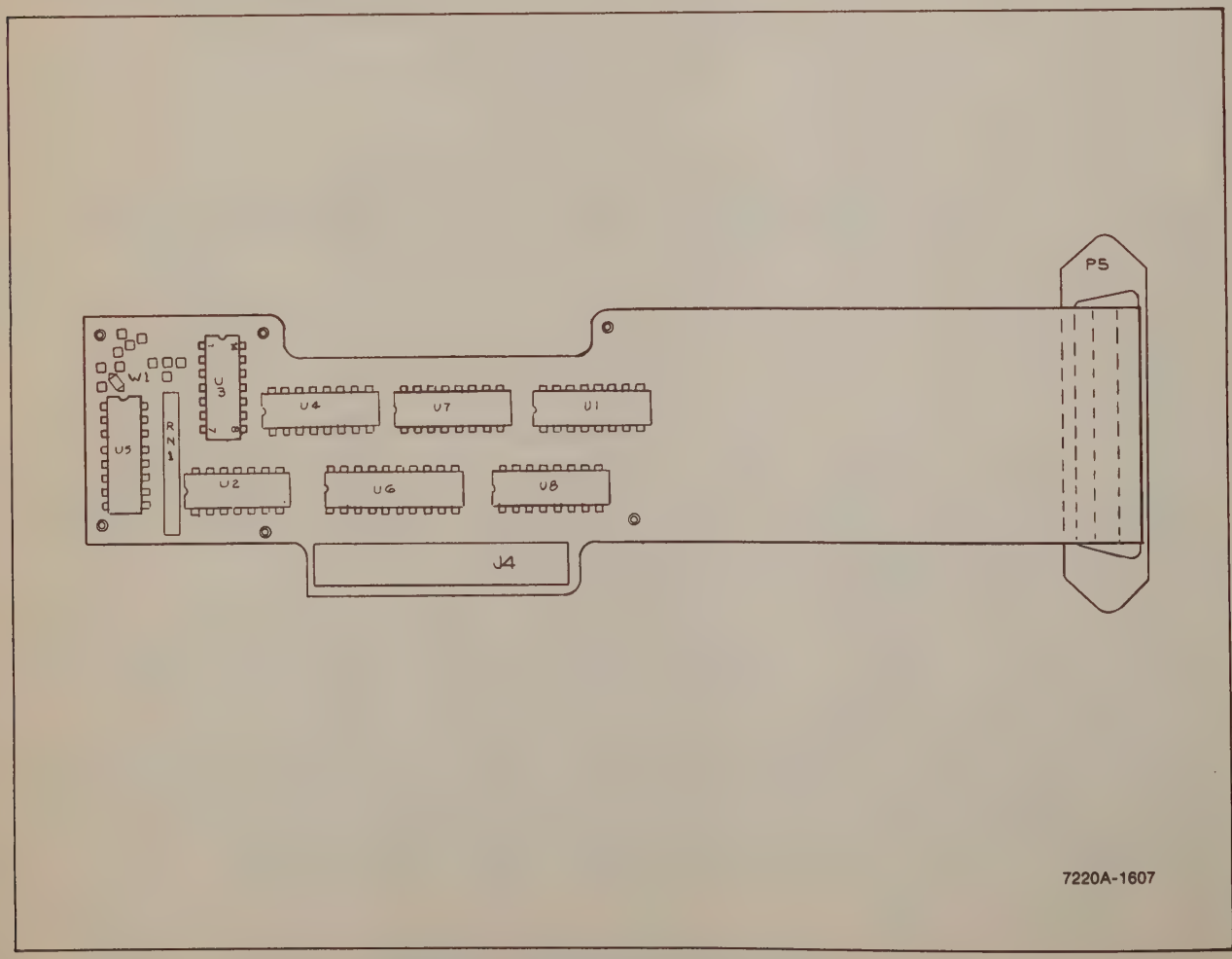


Figure 521-6. Digital Interface (Option -521)

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey
70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303
72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
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Measurement and Controls Div.
formerly Rustrak Instruments Co.
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96881
Thomson Industries, Inc.
Manhasset, New York

97540
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Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
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Centrelab Electronics Div. of
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El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

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Honolulu, HI 96819
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(801) 268-9331

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975 Industry Drive
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All other instruments are sold by the sales offices only.

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Elektronische Gerate GmbH & Co.
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M.B. Electronique S.A.
Rue Fourny 606, Z1 Centre
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B.P. No. 31
78530 BUC, France
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Sistrel S.p.A.
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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1. Numbered change information follows the table.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P								
A1	MAIN PCB ASSY	475152	●	●	●	1	2	3	4	6	7	X													
A2	FRONT PANEL ASSY	476028	●	●	●	X																			
A5	TIMEBASE PCB ASSY	538660	X																						
A6	10-100 MHz MULTIPLIER ASSY	475855	●	●	●	●	●	●	5	X															
-010	BATTERY PCB ASSY	475962	●	●	●	8	9	10	X																
-190	JITTERED TIME BASE ASSY	475988	●	●	●	X																			
-310	DIRECT CHANNEL C ASSY	476005	●	●	●	●	X																		
-331K A1	1300 MHz PRESCALER	475913	●	●	●	X																			
-331K A2	DC-DC CONVERTER ASSY	475889	●	●	●	X																			
-521	DATA I/O ASSY	487454	●	●	●	11	X																		

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
—= No revision letter on the PCB.

CHANGE #1 - 12515
Rev.- D, A1 Main PCB Assembly (7261A-4001T)

On page 5-12:
ADD: U4|IC, ECL, EDGE TRIGGERED J-K F/F|402743|07263|F95029DC|1|1
ADD: U8|IC, QUAD, DIFF. LINE RECEIVER|483933|01295|AM26L32N|1|1

On page 5-13:
DELETE: XU4|SOCKET, 16-PIN|370312|91506|316-AG39D|2
DELETE: XU8|SOCKET, 16-PIN|370312|91506|316-AG39D|REF

On page 5-4:
DELETE: U4|IC, ECL, EDGE TRIGGERED J-K F/F|402743|07263|F95029DC|1|1
DELETE: U8|IC, QUAD, DIFF. LINE RECEIVER|483933|01295|AM26L32N|1|1

CHANGE #2 - 12524, 12604, 12605
Rev.- E, A1 Main PCB Assembly (7261A-4001T)

On page 5-12:
DELETE: R83|RES, DEP. CAR, 27K ±5%, 1/4W|441501|80031|CR251-4-5P27K|1

On page 5-14 and 8-4:
Delete R83 and its symbol between pins 4 and 11 of U48.

On page 8-8: Delete R83 to U15-6.

On page 5-12:
ADD: R76|RES, COMP, 4.7K ±5%, 1/4W|148072|01121|CB4725|REF
ADD: R77|RES, COMP, 4.7K ±5%, 1/4W|148072|01121|CB4725|REF
DELETE: RN9|RESISTOR NETWORK, 4.7K ±2%, 1/8W|484063|89536|484063|1

On page 5-11:
Change the TOT QTY of R30, FROM: 8 , TO: 10.

On page 5-14 and 8-4:
Add R76, R77 and their symbols.
Delete RN9 and its symbol between U15 and J6.

On page 8-8:
Delete RN9 to pins; 28, 29, 30, 31, 33, 34, 36 and 37 of U15 .

ADD: R76, R77 and their symbols.

On page 5-10:
Change the TOT QTY of R14, FROM: 3, TO: 2

On page 5-12:
DELETE: R77|RES, COMP, 470 ±5%, 1/4W|147983|01121|CB4715|REF

On page 5-14 and 8-4:
Delete R77 and its symbol parallel to and between U43 and U44.

On page 8-7:
Schematically delete R77, 470, between U44-3 and J6-5.

CHANGE #3 - 12555
Rev.- F, A1 Main PCB Assembly (7261A-4001T)

On page 5-12:
FROM: U16|LINE RECEIVER ASSEMBLY|527234|89536|537234|1|1
TO: U16|IC, ECL, 2-INPUT, EXCLSV OR/NOR|473975|04713|MC10107P|1|1

On page 5-13:
Change the TOT QTY of XU4, FROM: 3, TO: 2
Change the TOT QTY of U5, FROM: 2, TO: 1
DELETE: XU16|SOCKET, 16-PIN|370312|91506|316-AGC39D|REF

FROM: U23|IC, ECL, QUAD, 2-INPUT, NOR |380881|04713|MC10102P|REF
TO: U23|IC, ECL, QUAD, 2-INPUT, NOR GATE|504431|07263|SN74S51N|1|1

CHANGE #4 - 12832, 13033, 13237, 13238
Rev.- G, A1 Main PCB Assy. (7261A-4001T)

On page 5-10:
CHANGE: JB2|CONNECTOR, POST|379438|00779|86144-5|1
TO: JB2|CONNECTOR, AMP PIN|484428|0079|9-87022-1|REF

CHANGE #5 - 13205
Rev.- G, A6 10-100 MHz Multiplier PCB Assy. (7261A-4003T)

On page 5-20:
CHANGE: Q1|XTSR, SI, NPN|454231|89536|454231|1|1
TO: Q1|XTSR, SI, NPN|454231|04713|BFR90|1|1

CHANGE #6 - 13491
Rev.- H, A1 Main PCB Assy. (7261A-4001T)

On page 5-12:
CHANGE: U19|IC, TTL, DUAL J-K F/F|363440|01295|SN74S112N|1|1
TO: U19|IC, TTL, DUAL J-K F/F|414029|01295|SN74LS112N|1|1

CHANGE #7 - 13968, 13977
Rev.- J, A1 Main PCB Assy. (7261A-4001T)

On page 5-9:
CHANGE: C20|CAP, CER, .0068 UF ±10%, 50V|342881|80031|75F1R5A687|1
TO: C20|CAP, CER, 5000 PF ±5%, 500V|181065|72136|DM15F502J|1

On page 8-8, change the value of C20, FROM: .0068 PF, TO: 5000 UF.

On page 5-3:
CHANGE: A5|TIME BASE PCB ASSY.|476572|89536|476572|1
TO: A5|TIME BASE PCB ASSY.|406918|89536|406918|1

On page 5-19:
CHANGE: A5|TIME BASE PCB ASSY.|476572|89536|476572|1
FIGURE 5-4 (7220A-4009)

TO: A5|TIME BASE PCB ASSY.|406918|89536|406918|1
FIGURE 5-4 (1952B-4010T)

On page 5-19 and 8-9, replace Figure 5-4 with Figure 7A-1:

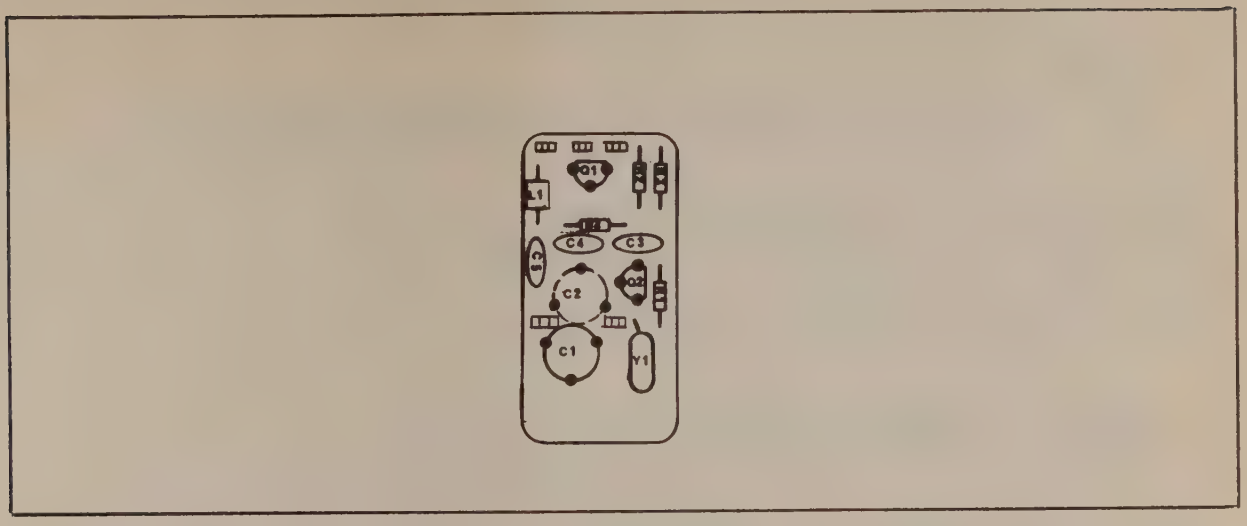

Figure 7A-1

On page 8-9, replace Figure 8-3 with Figure 7A-2:

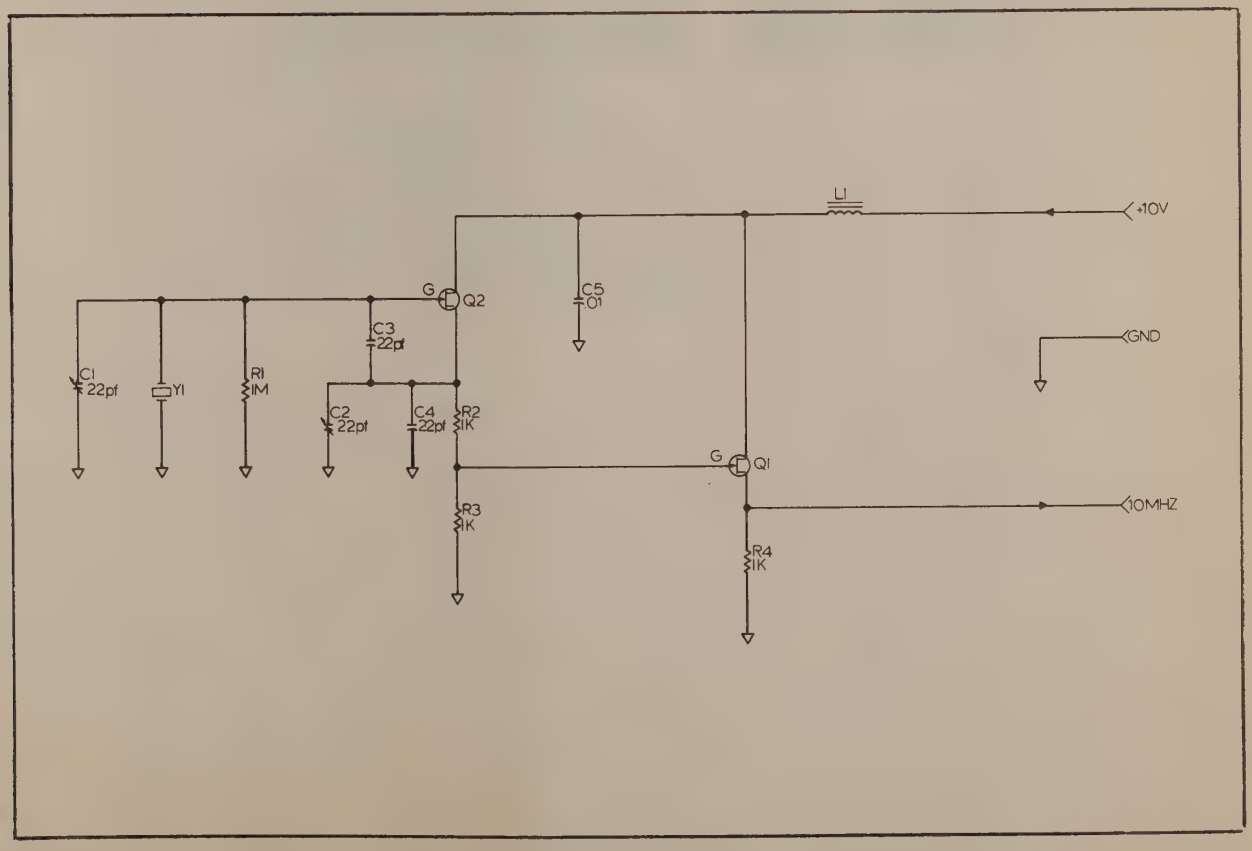

Figure 7A-2

CHANGE #8 - 12180
Rev.- D, Battery PCB Assy. (7220A-4010T)

On page 6010-9:
CHANGE: CR10|DIODE, ZENER, 7.5V ±5%|256446|04713|1N775A|1
TO: CR10|DIODE, ZENER, 6.8V |260695|07910|1N754A|1

CHANGE #9 - 12870
Rev.- E, Battery PCB Assy. (7220A-4010T)
Documentation Change, does not affect the manual.

CHANGE #10 - 13171
Rev.- F, Battery PCB Assy. (7220A-4010T)

On page 6010-9:
DELETE: H5|WASHER, FIBER|246488|73734|1471|1
DELETE: H6|WASHER,FLAT #8|110288|73734|97425|1

On page 6010-8:
Delete all reference to H5 and H6.

CHANGE #11 - 14201
Rev.- E, -521 Data Input/Output PCB Assy. (7220A-4007T)

On page 6521-8:
CHANGE: RN1|RES, NETWORK, 100K|544247|89536|544247|1
TO: RN1|RES, NETWORK, 100K|461038|89536|461038|1

Section 8
Schematic Diagrams

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Mnemonics

AECL	Channel A Emitter Coupled Logic.
AO, AR	Autoranging Feedback Lines
A TTL	Channel A Transistor-Transistor Logic
B1, B2, B4, B8	Binary Coded decimal bits for each counter stage.
BECL	Channel B Emitter Coupled Logic.
B TTL	Channel B Transistor-Transistor Logic
BY (or B)	BUSY from Control Logic when measurement cycle is in progress.
$\overline{\text{C DIR}}$*	Channel C without presclaing.
C ECL	Channel C Emitter Coupled Logic
CI	Control Logic Clock Input – 1 MHz (1/6 MHz)
CO	TTL output from Control Logic. High in PER AVG A, CHK. 1 MHz to 10 Hz for TI A-B.
CPM	Counts Per Minute X100A function has been selected.
$\overline{\text{C SIG}}$*	Synchronized signal present on Channel C above threshold level - start measurement.
D1 through D6	Digit 1 through Digit 6.
D1 CARRY	Digit 1 carry.
DP	Decimal Point.
DS1 through DS8	Strobe 1 through Strobe 8.
EA	TTL Output from the Control Logic
EH	TTL ouptut from the Control Logic. Enables the 10 MHz.
F1, F2, F4, F8	Function Control Lines.
F1L, F2L, etc.	Function Control Lines from the Front Panel (Local).
F1R, F2R, etc..	Function Control Lines from the Remote Interface (Remote).
FC	FREQ C Function is selected.
$\overline{\text{FILT}}$*	100 kHz Low Pass Filter Control Line.
FILTL	Front Panel Enable of the Filter (Local).
FILTR	Remote Enable of the Filter (Remote).
$\overline{\text{G}}$*	Gate Annunciator Enable
GC	Main Gate Clock.
$\overline{\text{GR}}$*	Main Gate Reset.
$\overline{\text{GS}}$*	Main Gate Set.
GQ	Main Gate Enable
$\overline{\text{HE}}$*	Time Interval Holdoff Enable.
HLDAN	Time Interval Holdoff Analog.
M1, M2, M3	Control Logic Mode Inputs.
$\overline{\text{M}}$*	Update Memory.
OVEN	Oven energized.
$\overline{\text{OF}}$*	Overflow Annunciator Enable.
P1, P2	Control Logic Prescale Inputs.
PA	Period A Function.
PAV	Period Average A Function.
R	General Reset.
$\overline{\text{R}}$*	Reset Display and Decade Counters.
RØ	Resolution Range Zero - 10^0/10 ns/10 kHz.
R1, R2, R3	Control Logic Resolution Range Inputs.
RI	Reset Input to the Control Logic.
$\overline{\text{REM}}$*	Remote Enable Line.
RRL	Range Reset Line.
$\overline{\text{RSTR}}$*	Remote Reset.
SCR	Remote Control Line for Single/Continuous selection.
SC	Single/Continuous Selection Line.
$\overline{\text{SLA +}}$*	Channel A Positive Slope Selection
$\overline{\text{SLA –}}$*	Channel A Negative Slope Selection
$\overline{\text{SLB +}}$*	Channel B Positive Slope Selection
$\overline{\text{SLB –}}$*	Channel B Negative Slope Selection
ST	Start Command
STR	Start Command from the Remote Interface
TI	Time Interval Function
TIA	Time Interval Average Function
TL	Trigger Light
TE	TTL Output from the Control Logic, high in TI
TQ	TTL Output from the Time Interval F/F. High at the end of measurements.
UX	Units Annunciation Control Line
XA	ECL Output of the Channel A Signal Conditioner
XB	ECL Output of the Channel B Signal Conditioner
X1, X2, X4, X8	First Decade Counter Output to 520 MHz Direct PCB.
X10	Times 10 attenuation of the input signal
X100	Times 100 attneuation of the input signal
Y1, Y2, Y4, Y8	D1/B1, B2, B4, B8 } inputs from the 520 MHz Direct PCB
Z1, Z2, Z4, Z8	D2/B1, B2, B4, B8 } inputs from the 520 MHz Direct PCB

* Low True

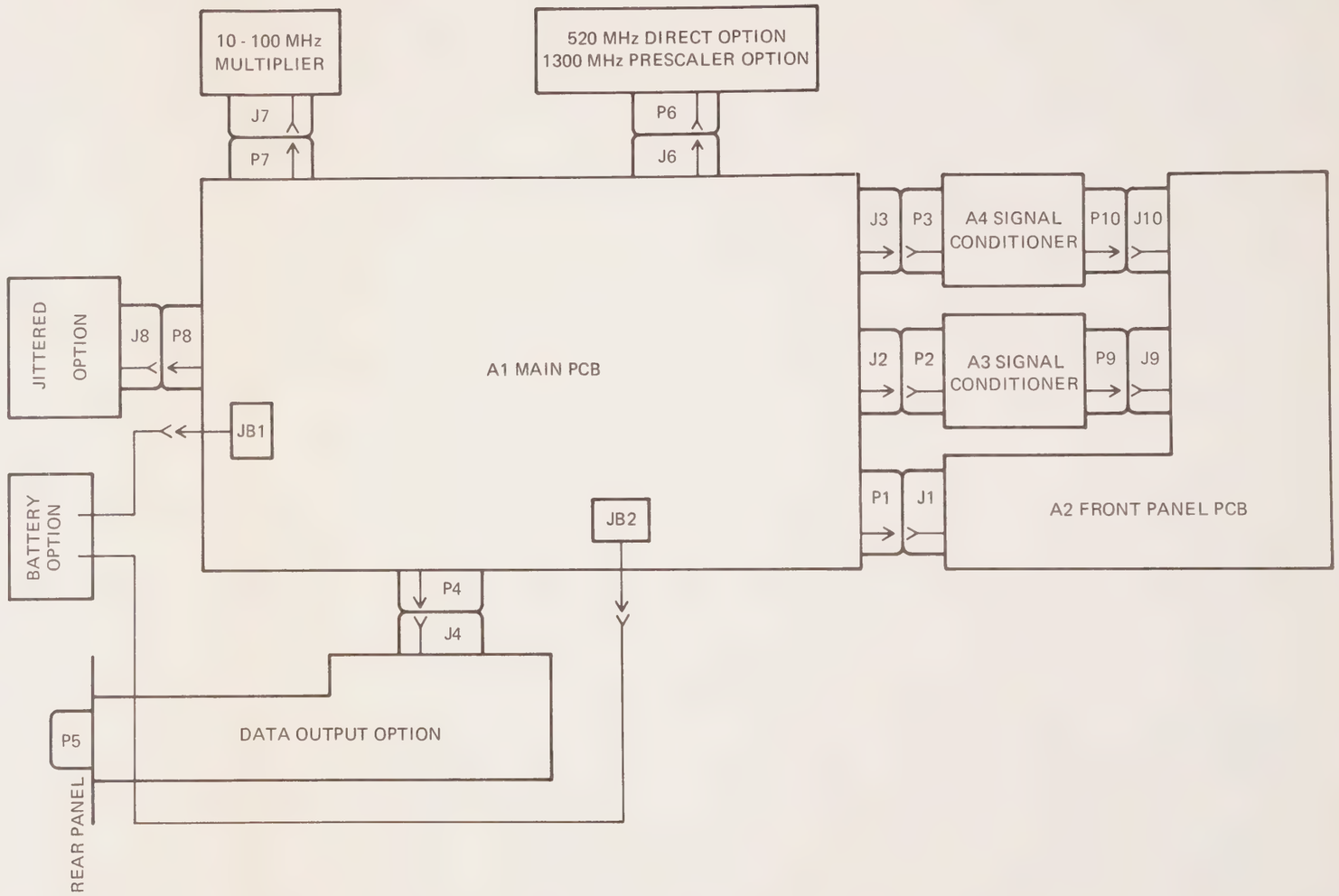
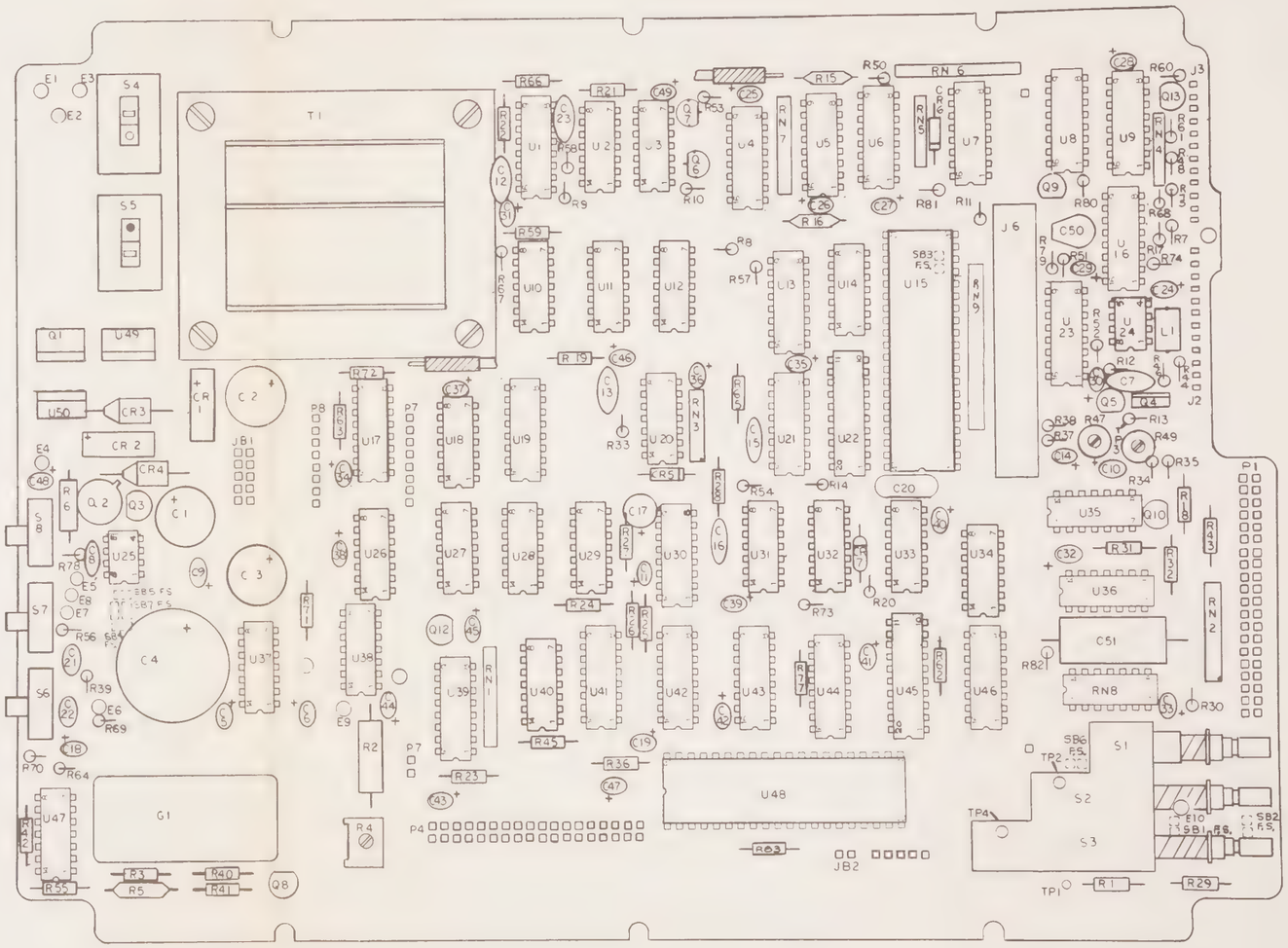


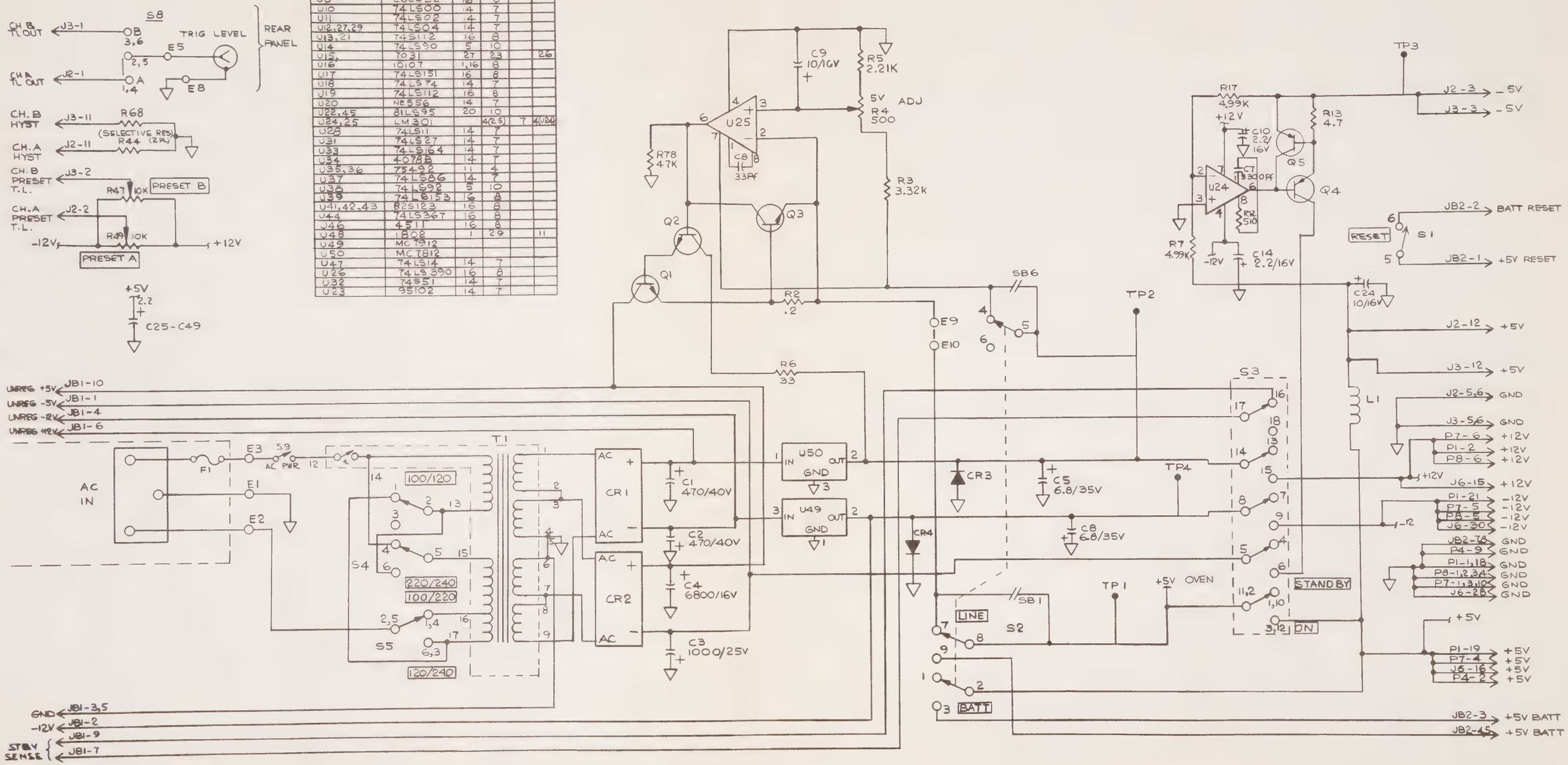
Figure 8-1. Interconnect Diagram



7261A-1601

Figure 8-2. A1 Main PCB Assembly

REF DES	TYPE	+5	GND	+12	-12
U1,30	74LS221	16	8		
U2,40	74LS51	14	7		
U3	74S04	14	7		
U4	95029	1,16	8		
U5	10102	1,16	8		
U6	10109	1,16	8		
U7,9	10131	1,16	8		
U8	26LS32	16	8		
U10	74LS00	14	7		
U11	74LS02	14	7		
U12,27,29	74LS04	14	7		
U13,21	74S112	16	8		
U14	74LS90	5	10		
U15,	7031	27	23		26
U16	10107	1,16	8		
U17	74LS151	16	8		
U18	74LS74	14	7		
U19	74LS112	16	8		
U20	NE556	14	7		
U22,45	81LS95	20	10		
U24,25	LM301		4(2,5)	7	4(2,4)
U28	74LS11	14	7		
U31	74LS27	14	7		
U33	74LS164	14	7		
U34	4078B	14	7		
U35,36	75492	11	4		
U37	74LS86	14	7		
U38	74LS92	5	10		
U39	74LS153	16	8		
U41,42,43	82S123	16	8		
U44	74LS367	16	8		
U46	4511	16	8		
U48	1808	1	29		11
U49	MC7912				
U50	MC7812				
U47	74LS14	14	7		
U26	74LS390	16	8		
U32	74S51	14	7		
U23	95102	14	7		



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS.
   ALL CAPACITORS ARE IN MICROFARADS.

7261A-1001
Sheet 1 of 4

Figure 8-2. A1 Main PCB Assembly (cont)

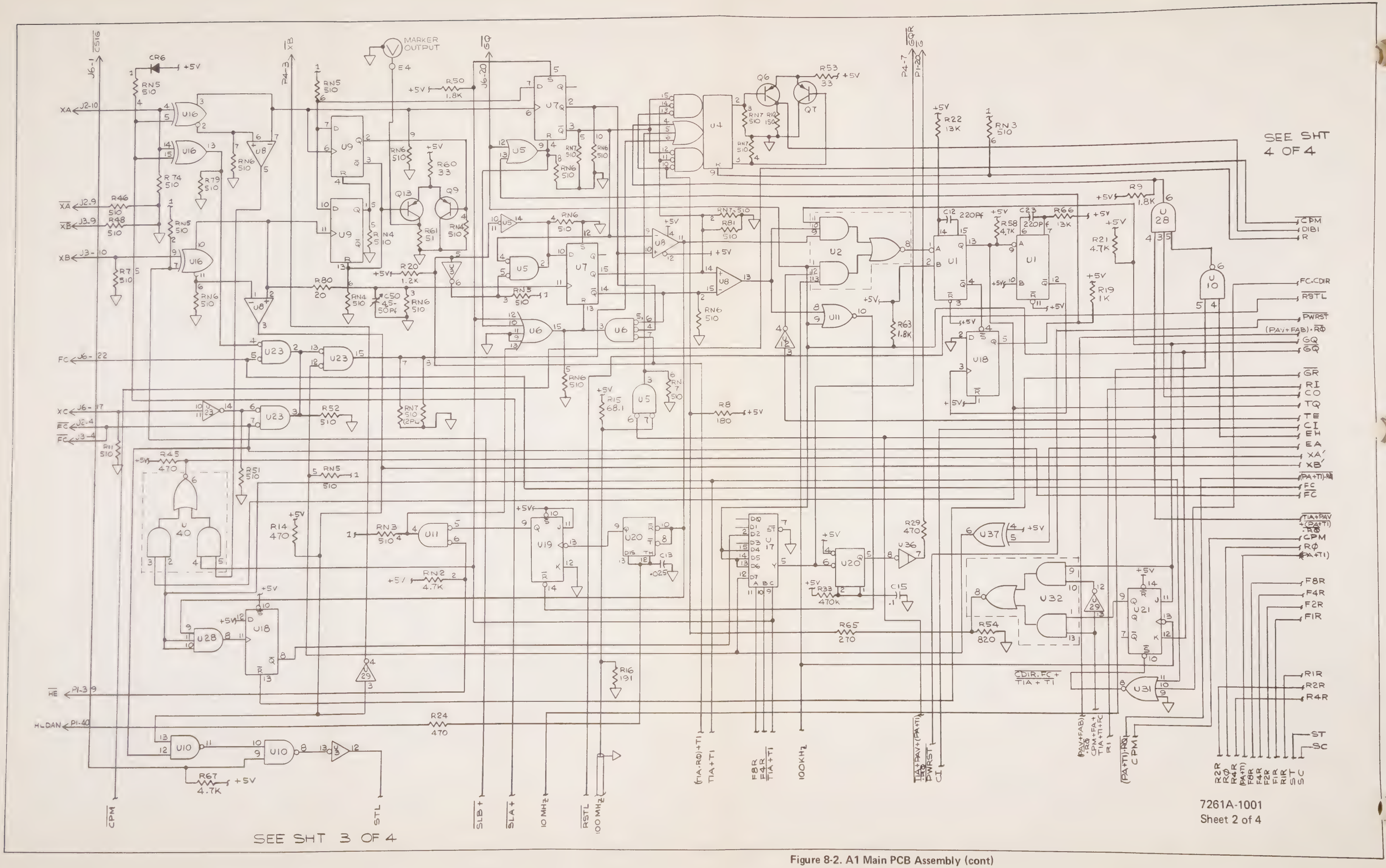
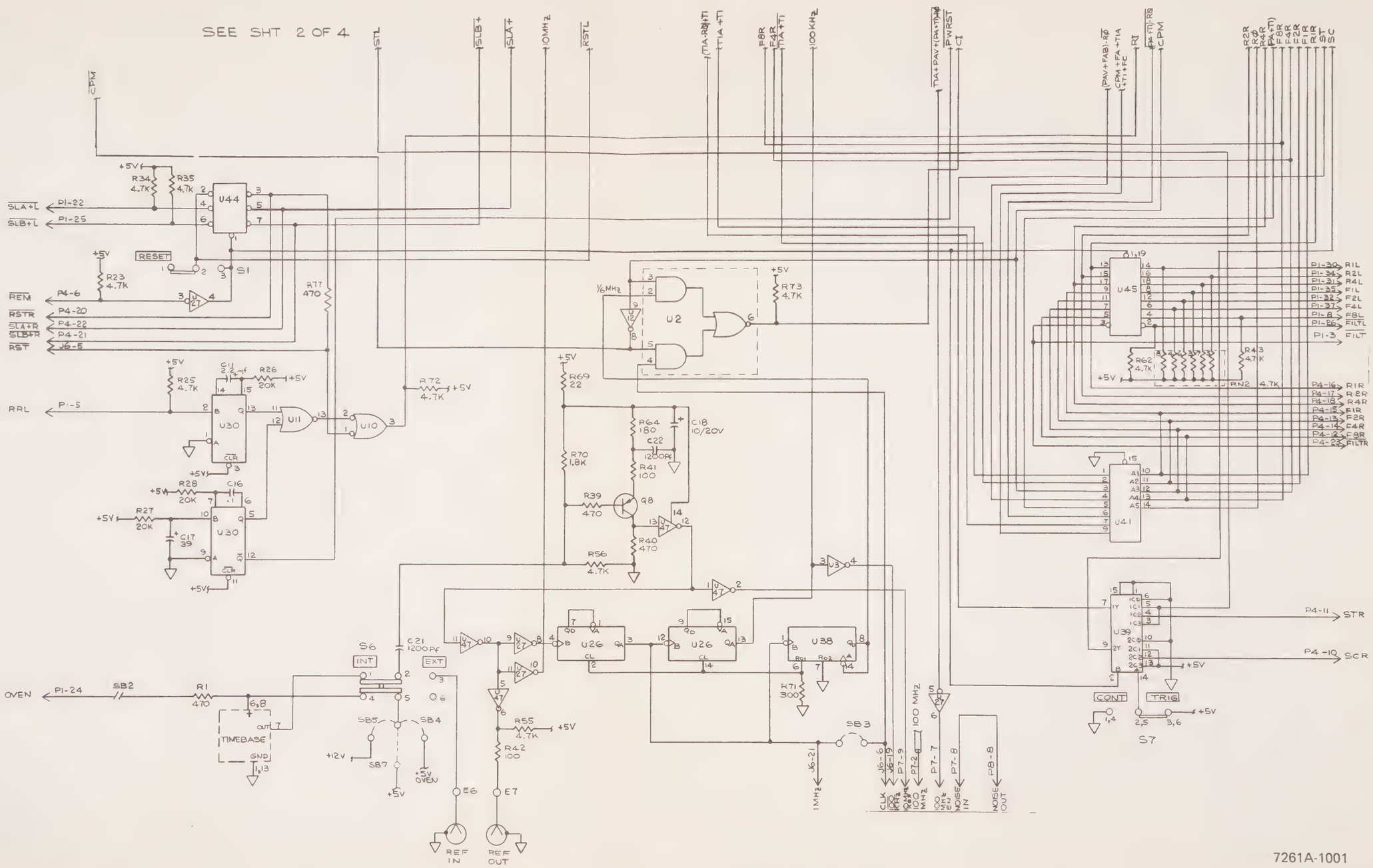


Figure 8-2. A1 Main PCB Assembly (cont)



7261A-1001
Sheet 3 of 4

Figure 8-2. A1 Main PCB Assembly (cont)

SEE SHT 2 OF 4

U48

U15

U42

U43

U46

U40

U32

U33

U34

U11

U31

U5

U37

U19

U22

U14

U21

U13

U35

U36

U38

U29

U27

RN1 4.7K

RN3 510

RN8 39Ω

R59 4.7K

R57 4.7K

R82 1.3

C51, 330/6V

C20 .0068

C19 1μF

R83 27K

R18 470

R30 4.7K

R31 47

R32 47

10K(2PL)

CR5

CR7

Q10

Q12

-12V

+5V

OSC

SCAN

RST

GND

P1-6 DS1

P1-27 DS2

P1-29 DS3

P1-12 DS4

P1-14 DS5

P1-15 DS6

P1-16 DS7

P1-17 DS8

P1-38 OF

P4-19 B1

P4-32 B2

P4-33 B4

P4-34 B8

P4-36 DS9

P1-7 a

P1-11 b

P1-9 c

P1-36 d

P1-13 e

P1-10 f

P1-28 g

P1-33 DP'

P1-4 Ux'

P4-4 Ux

P4-5 DP

P4-8 BY

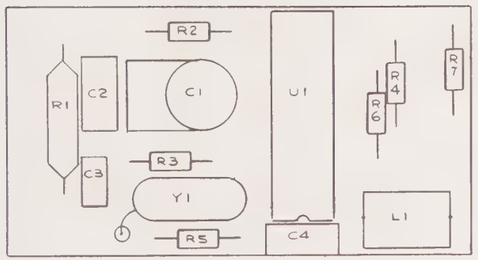
P8-7 TIA

P6-14 P2

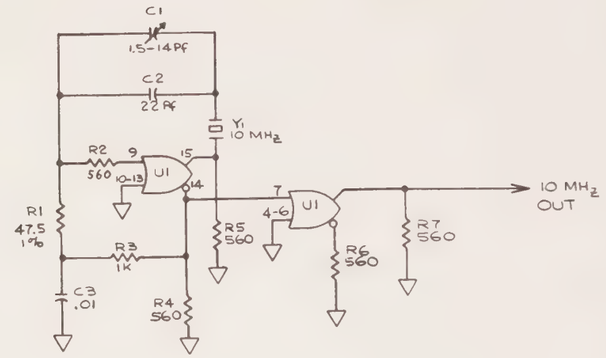
P6-29 P1

7261A-1001
Sheet 4 of 4

Figure 8-2. A1 Main PCB Assembly (cont)

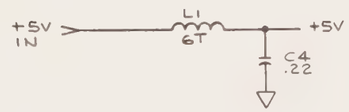


7200A-1609



NOTES :

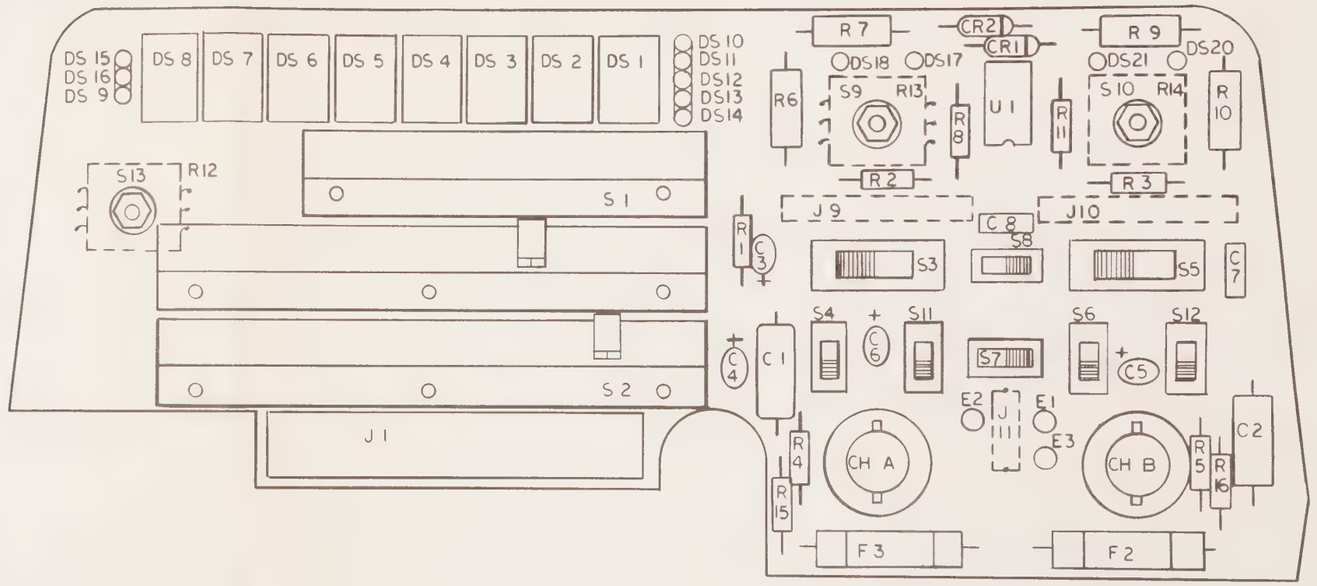
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/8W.
   ALL CAPACITORS ARE IN MICROFARADS.



QTY	DEVICE	+5V	GND	REF DES
1	MC10109	1,16	8	U1

7220A-1009

Figure 8-3. A5 Time Base PCB Assembly



7260A-1602

Figure 8-4. A2 Front Panel PCB Assembly

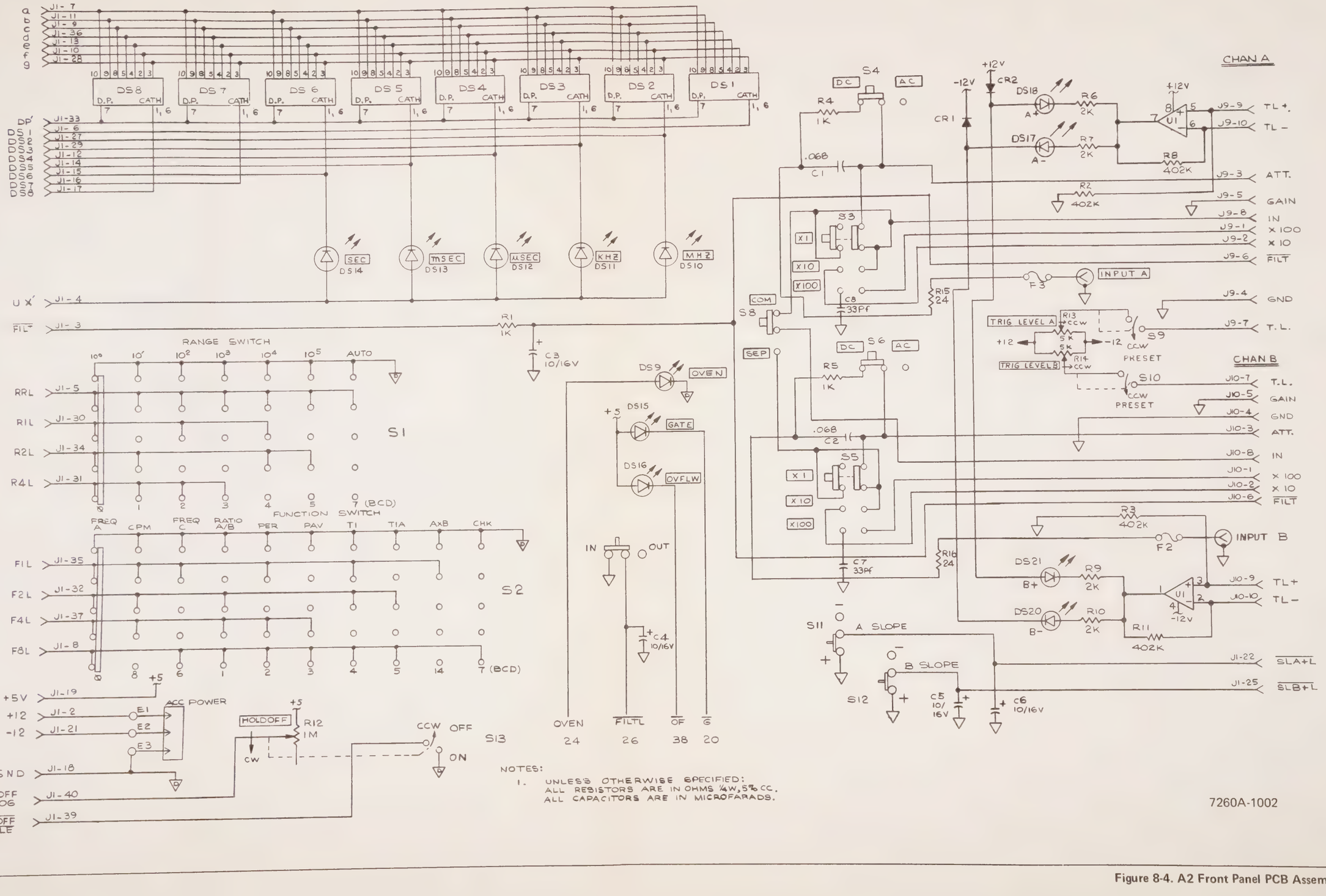
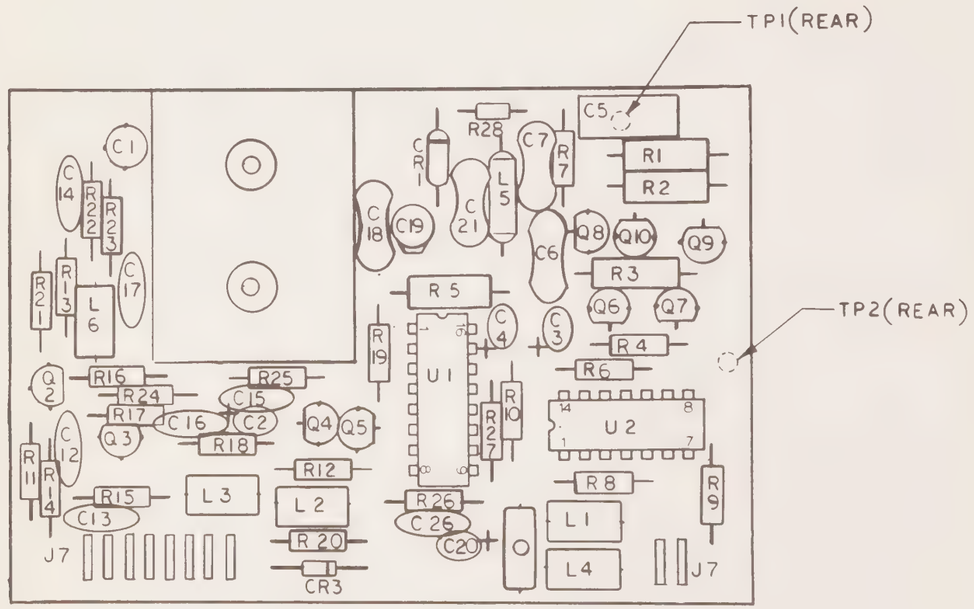


Figure 8-4. A2 Front Panel PCB Assembly (cont)



7261A-1603

Figure 8-5. A6 10-100 MHz Multiplier PCB Assembly

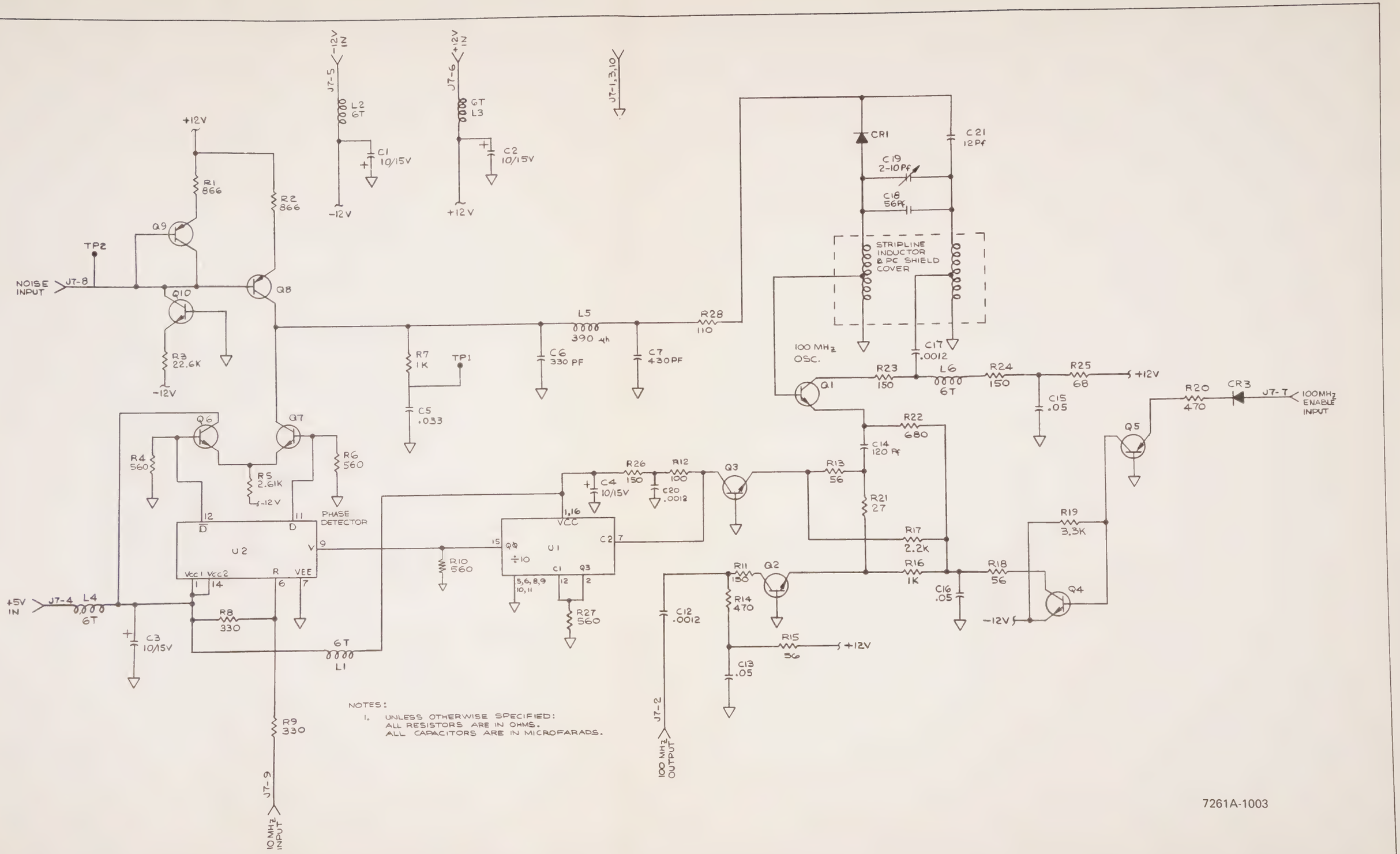
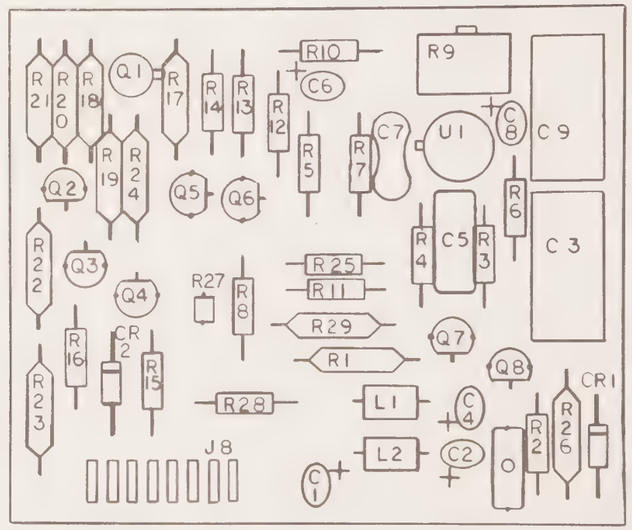
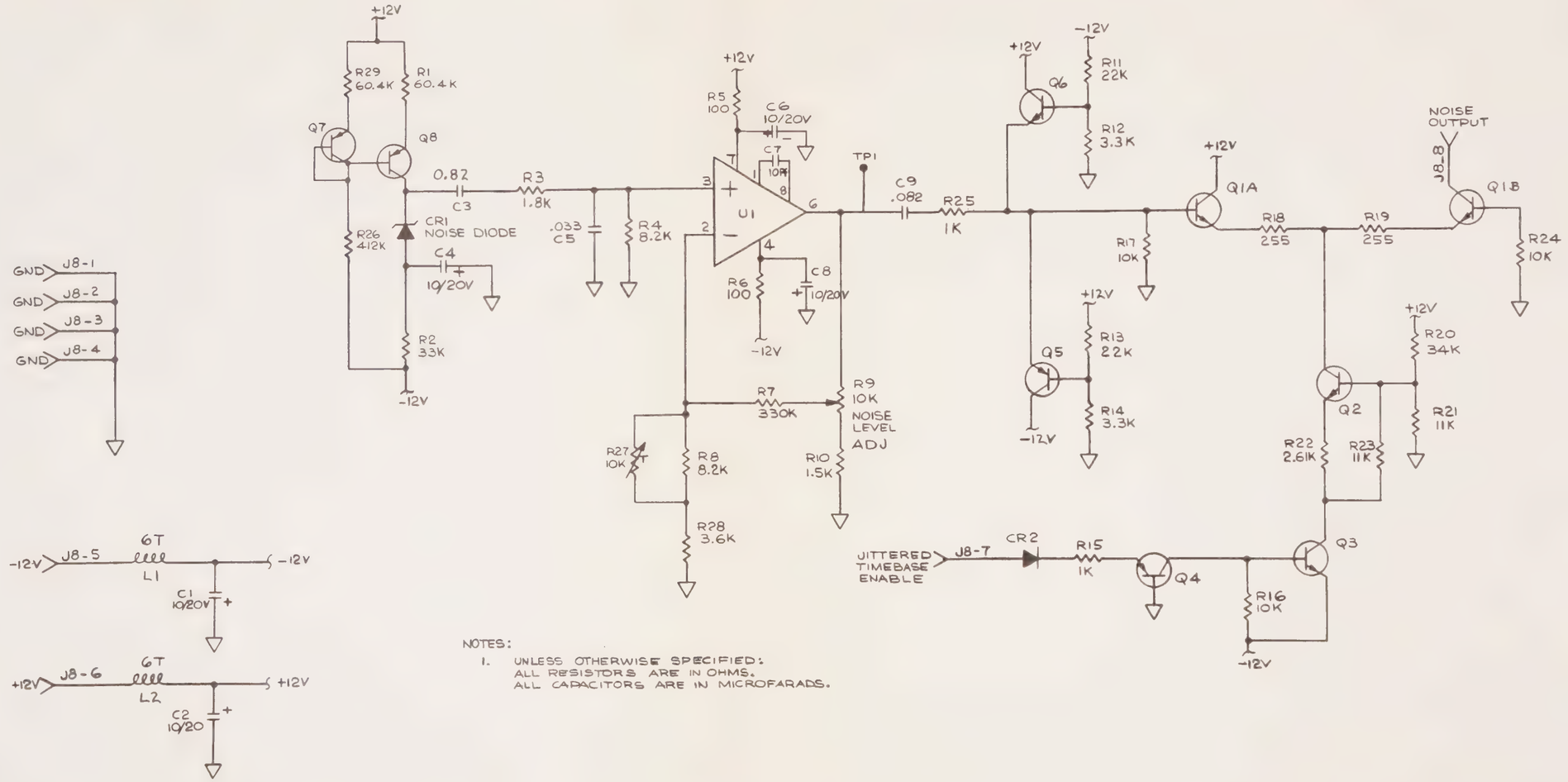


Figure 8-5. A6 10-100 MHz Multiplier PCB Assembly (cont)



7261A-1604

Figure 8-6. Jittered Time Base PCB Assembly
Option -190

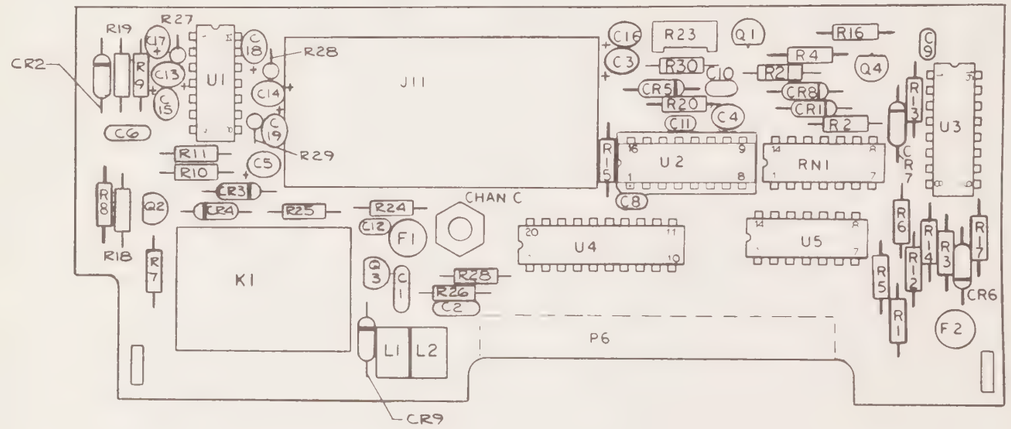


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS.
   ALL CAPACITORS ARE IN MICROFARADS.

7261A-1004

Figure 8-6. Jittered Time Base PCB Assembly
Option -190 (cont)



7260A-1603

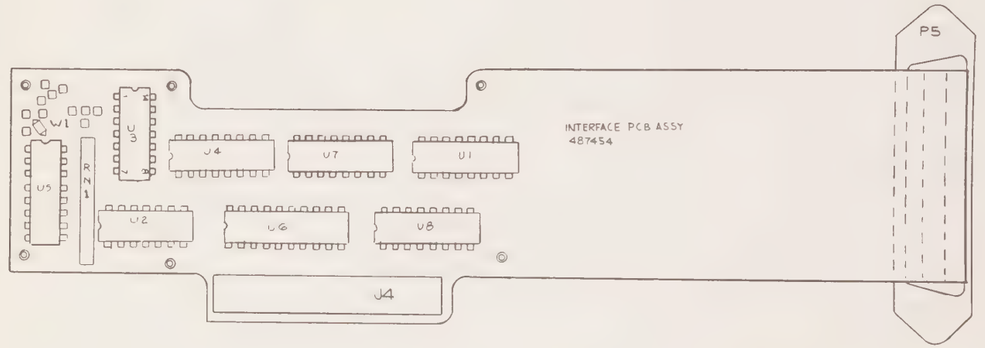
Figure 8-7. 520 MHz Direct PCB Assembly
Option -310

TABLE I				
REF DES	TYPE	+5V	GND	+12V
U1	CA324	—	—	4
U2	SP8635B	12	4,5,6,13,15	
U3	MC10131	1,16	8,9	
U4	81LS95	20	10	
U5	LM139	—	12	3

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTOR VALUES ARE IN Ω.
2. ALL CAPACITOR VALUES ARE IN uf.
3. POWER CONNECTIONS SEE TABLE I.

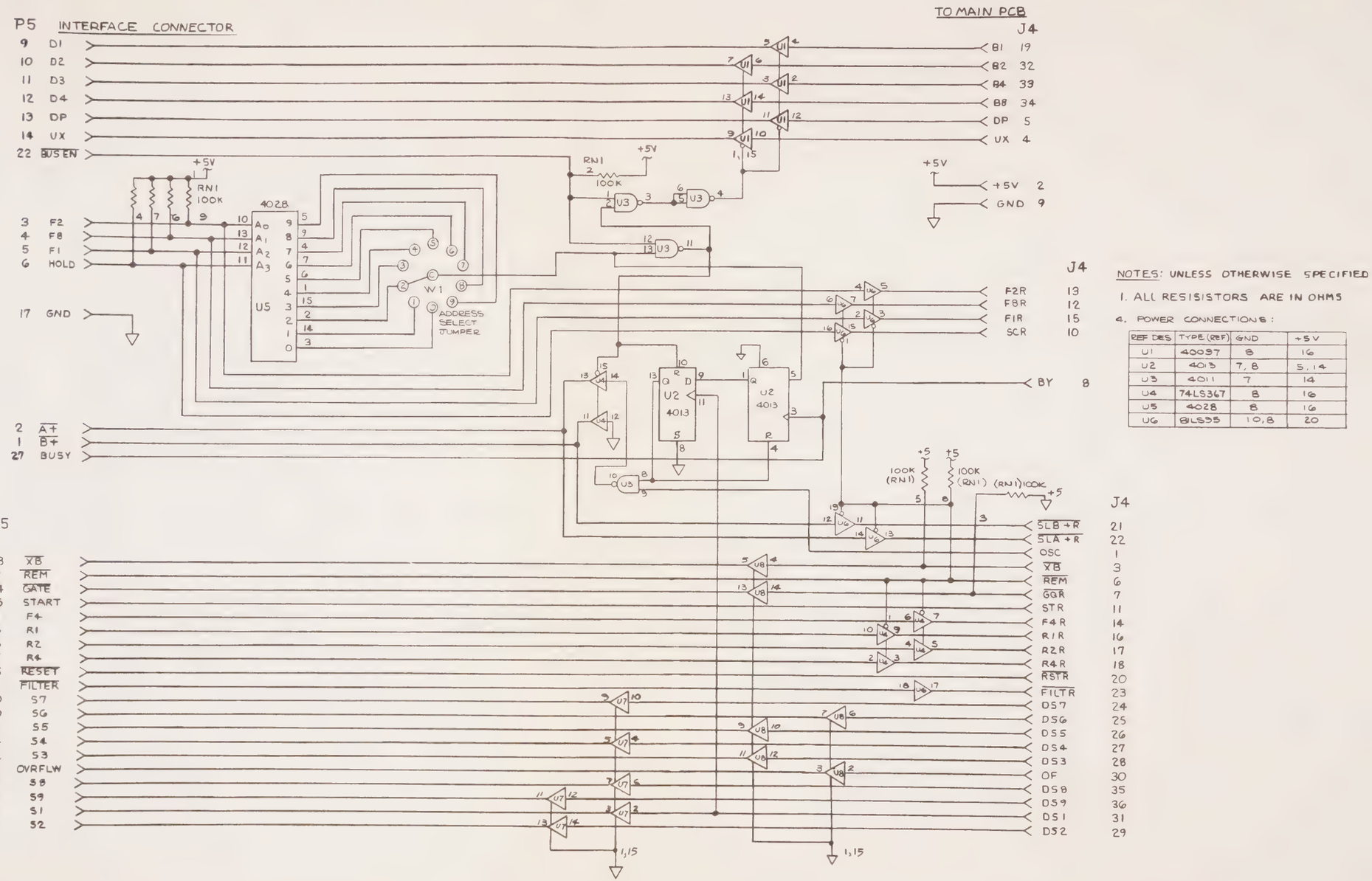
7260A-1003

Figure 8-7. 520 MHz Direct PCB Assembly Option -310 (cont)



7220A-1607

Figure 8-8. Data Input/Output Unit PCB Assembly
Option -521



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISISTORS ARE IN OHMS

4. POWER CONNECTIONS:

REF DES	TYPE (REF)	GND	+5V
U1	40097	8	16
U2	4013	7, 8	5, 14
U3	4011	7	14
U4	74LS367	8	16
U5	4028	8	16
U6	81LS95	10, 8	20

7220A-1007

Figure 8-8. Data Input/Output Unit PCB Assembly Option -521 (cont)

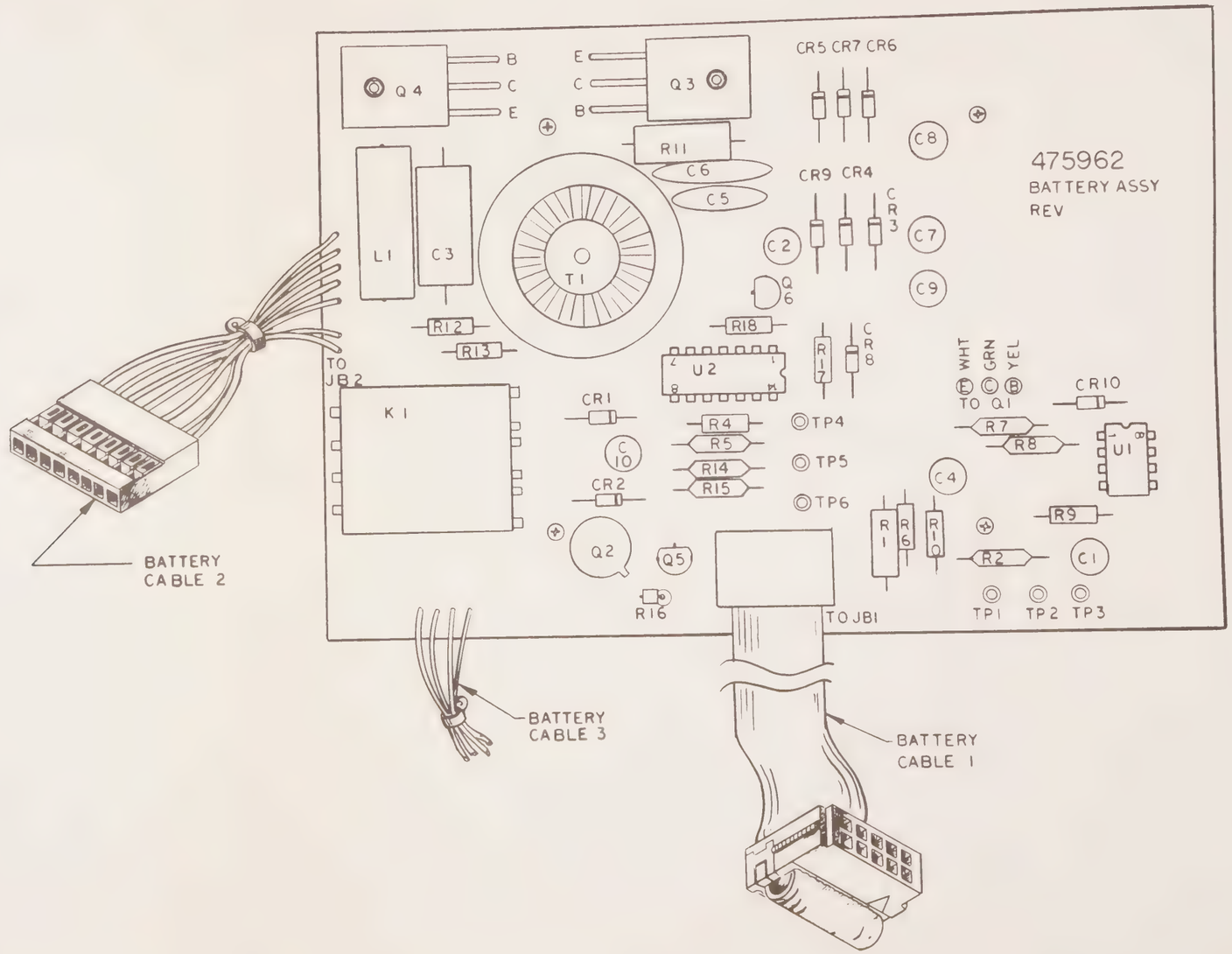


Figure 8-9. Battery PCB Assembly Option -190

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS.
2. BATTERY GROUND INDICATED ⏚.

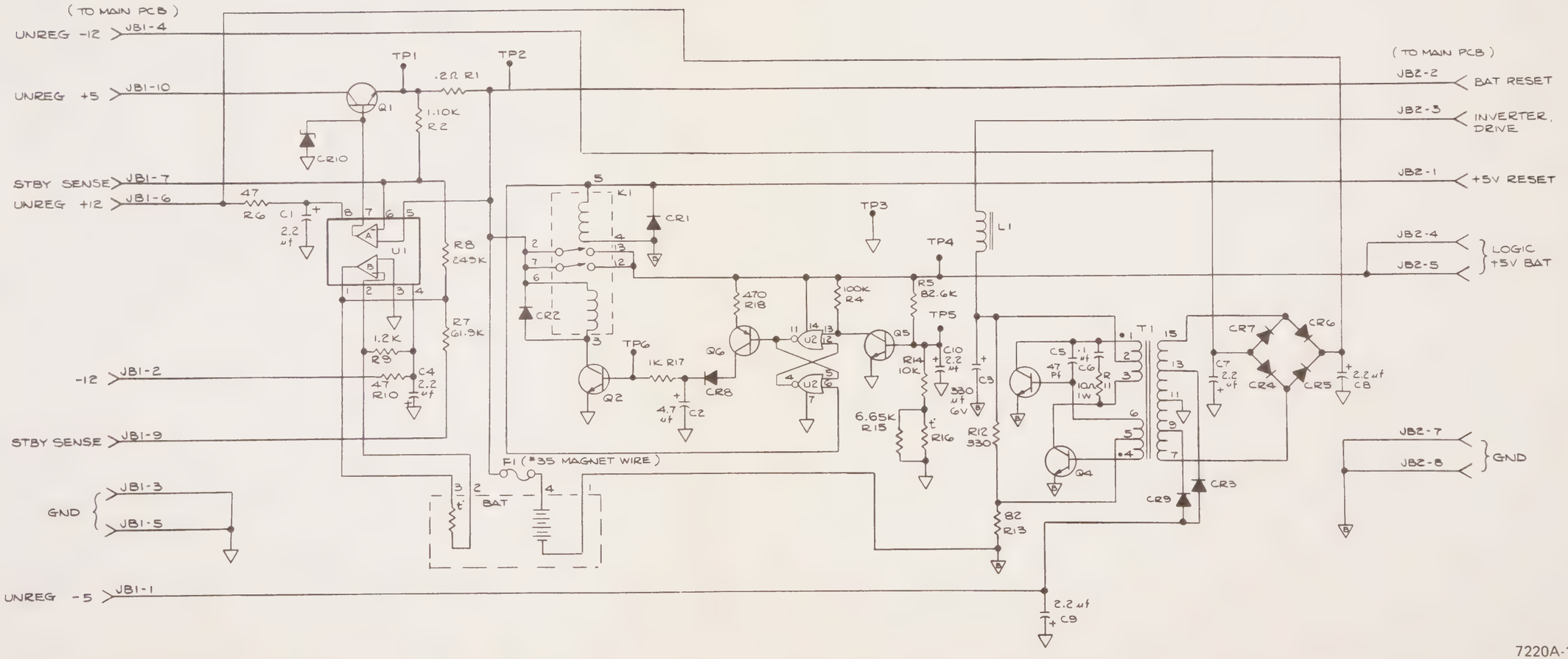
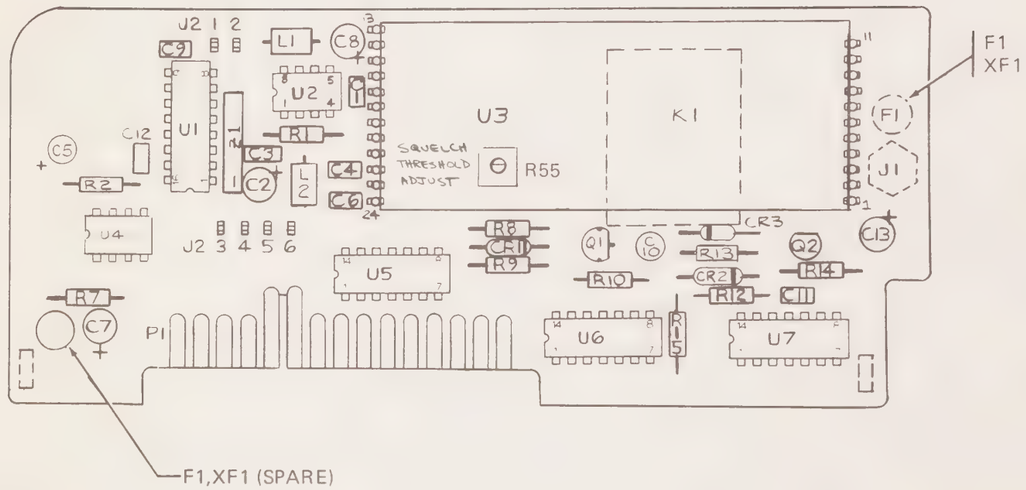


Figure 8-9. Battery PCB Assembly Option -190 (cont)



7260A1604

Figure 8-10. 1300 MHz Prescaler PCB Assembly Option -331

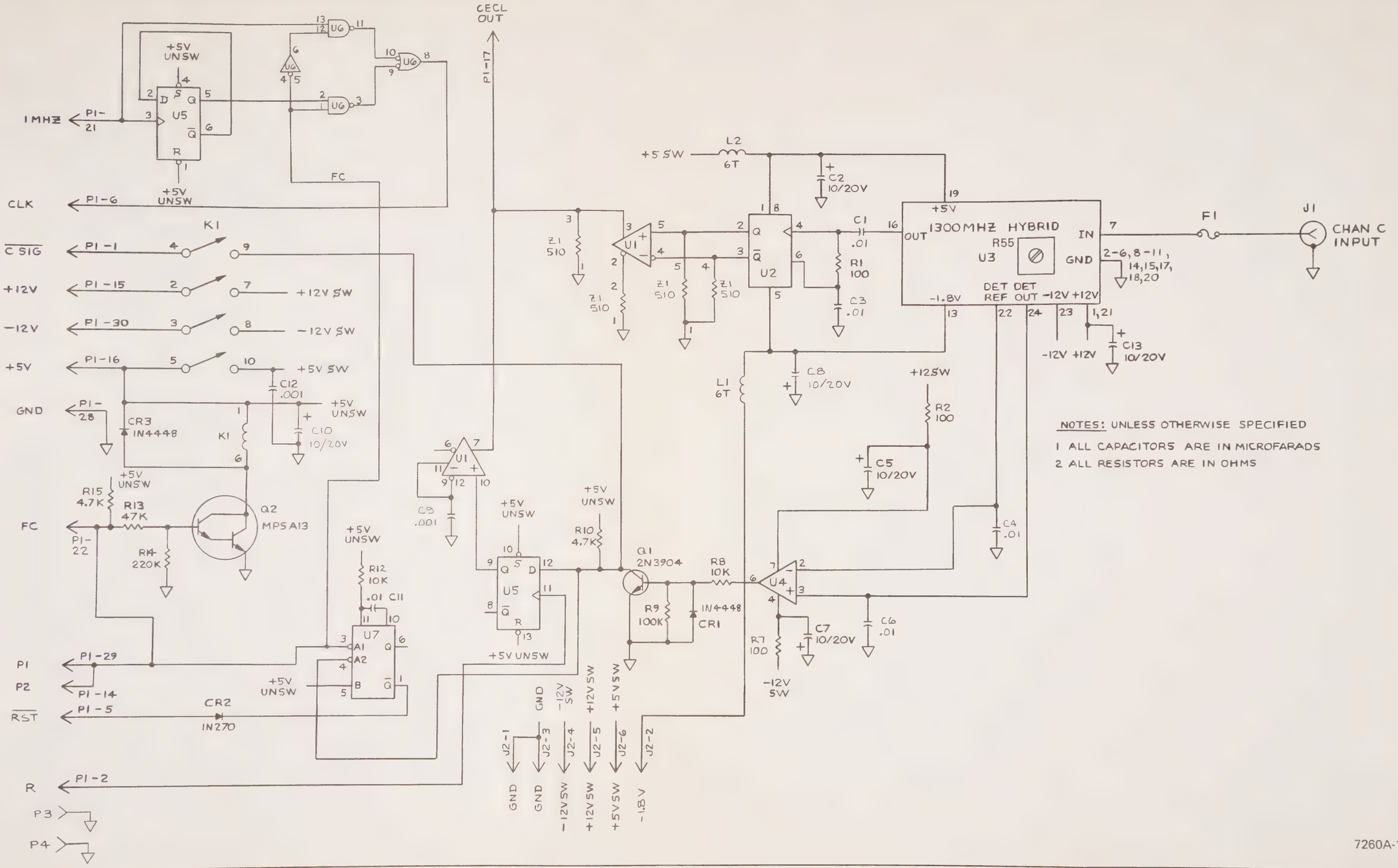
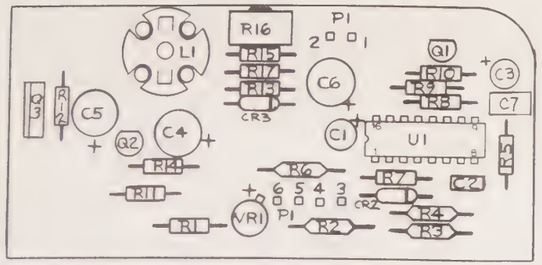
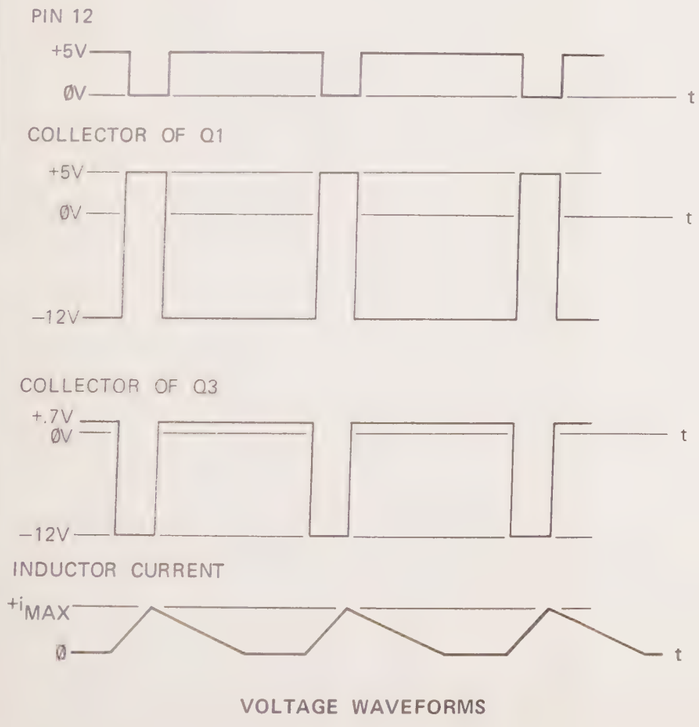


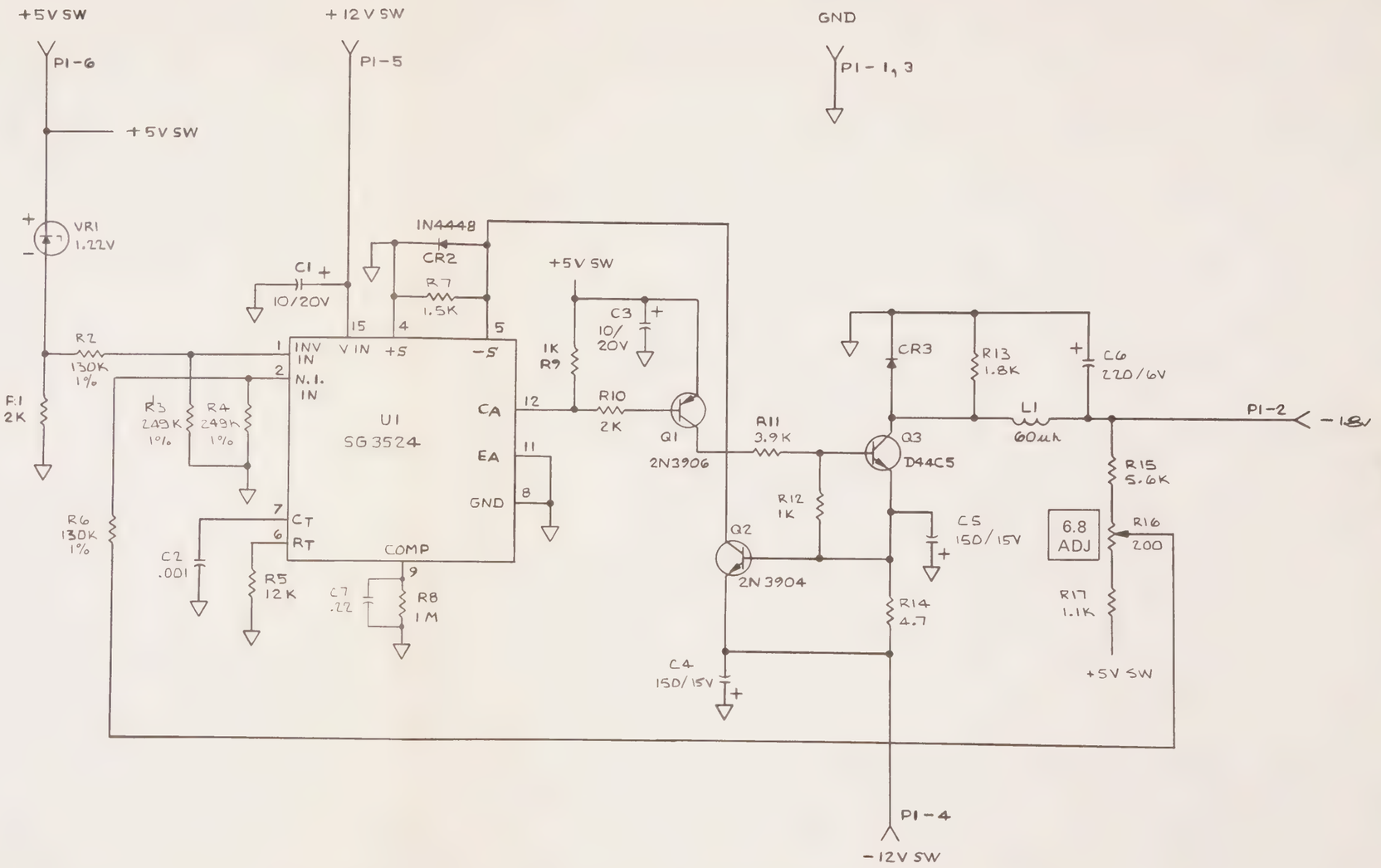
Figure 8-10. 1300 MHz Prescaler PCB Assembly Option -331 (cont)



7260A-1605



VOLTAGE WAVEFORMS



7260A-1005

NOTES: UNLESS OTHERWISE SPECIFIED

1 ALL CAPACITANCE IN MICROFARADS.
2 ALL RESISTANCE IN OHMS.

Figure 8-11. DC to DC Converter PCB Assembly
Option -331

Application Bulletin

FLUKE

AB-39

Practical Counter Applications

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Introduction

This application bulletin presents a few of the many applications possible with Fluke counters. The applications presented here are for the counters by themselves and in conjunction with other instruments. The general notes in Section 1 are intended as an aid to solving the difficult problem of measuring signals with super-imposed noise.

For more information about these applications or about other possible applications contact your nearest Fluke sales office or call the factory in Seattle at (206) 774-2481.

Section 1
Input Signal Processing

General Notes

All counters contain input signal conditioning circuitry whose function is to accept an analog signal of random shape and level, and convert it to a digital signal that can be measured by the counter. Trouble arises when noise and unwanted signals superimposed on the signal are large enough to be sensed by the input. The result can be false counting and readings that vary over a wide range in a random fashion.

There are many different kinds of noise: Ringing caused by unterminated cables, noise from ground loops, noise inherent in the signal source, and radiated noise or RFI. There are various mechanisms to prevent this noise affecting the counter.

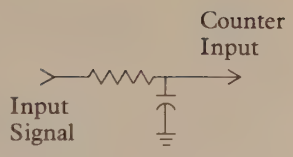
The counter operator can try shielding the cable and the counter to keep RFI out, terminating the cable at the counter to stop signal ringing, breaking grounds to prevent ground loops, filtering the signal to remove the noise, attenuate or reduce the signal level which will tend to reduce the amplitude of noise on the signal.

Attenuation is usually the easiest first choice as many counters have this feature built in, if not, external in-line attenuators, or pads, can be used. Attenuating the signal attenuates superimposed noise at the same time, reducing the noise to a point where the counter will not be affected by it. Filtering the signal is also an effective way to get rid of noise. If the counter does not have an internal filter, an external filter network may be made.

The following is an example that illustrates how to design a simple low pass filter to remove high frequency noise from a signal. (High frequency noise is one of the most common causes of false counting and unstable displays in counters.)

Example: You are measuring a frequency around 800 kHz, and would like to cut-off all frequencies above 1 MHz. Using the schematic in Figure 1 and assuming a 1K series resistor you can calculate the value for the capacitor using the following formula:

$$C = \frac{1}{2\pi fR}$$
$$= \frac{1}{(2)\ (3.14)\ (1x10^{6})\ (1x10^{3})}$$
$$= 1.59 \times 10^{-10}$$
$$= 159 \text{ pf}$$



You would select a capacitor as close to 159 pf ±10% as you can get. When you build the filter, be sure to keep the lead lengths short and the circuit lay-out well grounded, this will keep the noise from "leaking" around the filter.

By keeping the R value at 1K ohm, we can then come up with a handy table of cut-off frequencies in multiples of 1 MHz.

Table 1

f cut-off	R(ohms)	C
1 MHz	1000	159 pf
100 kHz	1000	1590 pf
10 kHz	1000	.0159 μf
1 kHz	1000	.159 μf

APPLICATION 1-1

Using A Voltmeter for Input Signal Processing

For low frequency measurements, a voltmeter with the proper output, and counter may be used together to extend the sensitivity range of the counter and to effectively float the counter input above or below ground.

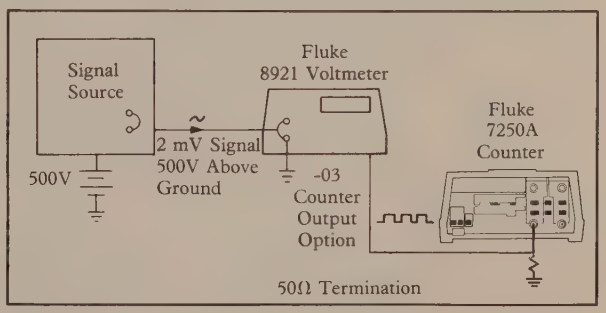


Figure 1

The Fluke 8921A in the example is a 20 MHz RF Voltmeter with a floating input. It can measure signals as small as 2 mV rms and elevated by as much as ±500V with respect to ground.

APPLICATION 1-2

Using A Scope for Input Signal Processing

An oscilloscope and a counter can be used together to make a superior measurement system. In this system the scope is used to condition the signal before it reaches the counter.

The scope can amplify, filter or attenuate the signal. Using a scope with a vertical signal out, the hookup would be as follows.

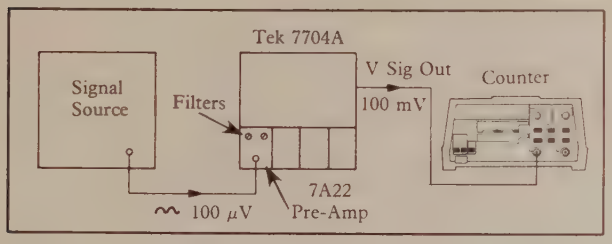


Figure 2.

In the above case, the 100 μV signal, which would normally be too small to be counted, is effectively amplified by the scope.

The 7A22 in the example has switch selectable low and high filters to further condition the signal if necessary.

APPLICATION 1-3

Floating Measurements of Computer Signals Using Battery Option

The battery option is very handy for testing large digital systems since it allows the counter to be connected directly into the circuit at any point without introducing power line ground currents. A X10 oscilloscope probe can be used to minimize capacitive loading in high speed circuits. Personal caution must be taken to avoid dangerous voltages while making floating measurements, as the external metal parts of the counter will assume those voltages.

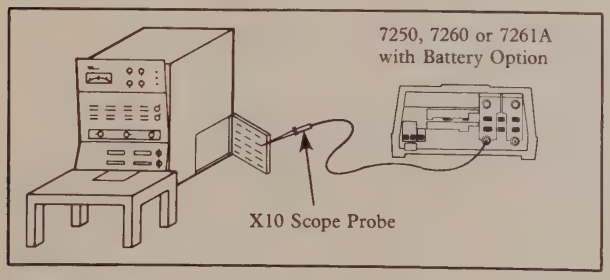


Figure 3.

Section 2
Measuring RF Transmitter Frequencies

Sample and Hold For Measuring CB Transmitter Frequencies

A CB carrier frequency may be measured without tieing up the channel for a lengthy period of time if the counter has a switch selectable external timebase input. See the counter to the frequency function and to the resolution desired. Key on the transmitter and adjust the distance between the antennas until a stable reading is obtained. Switch to the external timebase mode. The counter will immediately stop gating and *hold the reading* until you return the switch to the internal timebase mode. When using batteries with the antenna, we recommend a sepa[illegible] ground connection to prevent noise pickup. This is [illegible] pecially true when using the high impedance 1 MΩ input.

This may also be measured on the 7260A or 7261A by: slide the CONT/TRIG switch to the TRIG mode at the rear of the counter, with the B channel slope selector in the + position. Key the transmitter on and place it the same distance away from the counter, adjust the B trigger control slowly until the reading appears. It will now hold the display when the transmitter is keyed off.

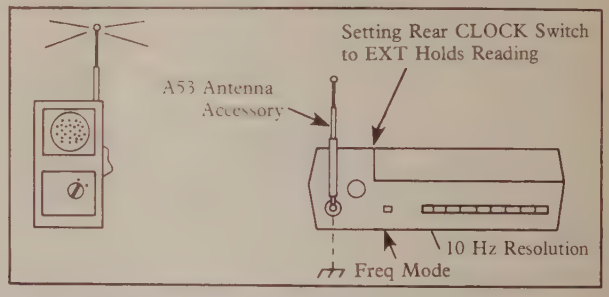


Figure 4.

Section 3
Period Measurements and Low Frequency High Resolution Measurement

APPLICATION 3-1

Using Period Average Mode for High Resolution at Low Frequency

For low frequency signals, the Period Average Mode offers higher resolution and faster display update rate than the frequency mode.

Example: Calibrate the line frequency of a portable power generator.

Using Frequency Mode the best resolution obtainable is 0.1 Hz (three digits) with a display update each 10 seconds. For Period Average Mode a calculator is used to calculate the precise period of 60 Hz. Period = 1/frequency = 16.66666 milliseconds. The generator is then adjusted until the counter display reads 16.66666 ms. Selecting Period Average Mode produces 7 digits of resolution in less than 1 second. Note that both resolution and update rate are substantially better than the frequency mode.

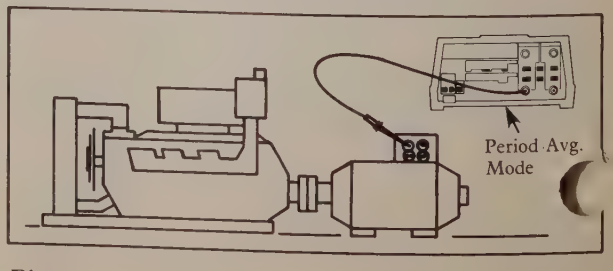


Figure 5.

APPLICATION 3-2

Heterodyne to Increase Resolution

In telecommunications it is common to calibrate signal sources to accuracies of $1x10^{-7}$ or $1x10^{-8}$. You can use a counter with a high stability timebase to do this. But what do you do when the desired accuracy is $1x10^{-10}$? There is a way to do this that will give you .1 MHz resolution and accuracies in the order of 10^{-10} to 10^{-11}. Consider the block diagram below.

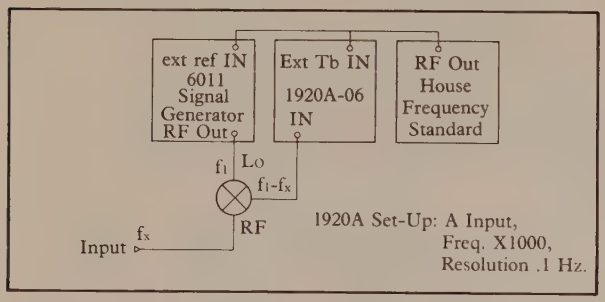


Figure 6.

We see a 6011A signal generator, a 1920A counter with option -06 (resolution multiplier) and, for best possible accuracy, couple both to a primary frequency standard to use as the measurement system timebase.

The principle of the measurement is to mix the input frequency with a reference frequency and then measure the difference frequency. To make sure that we always have a frequency difference, and not a frequency sum, at the mixer output, the reference frequency from the 6011A is set 1 kHz higher than the frequency we want to measure. Using a difference frequency of less than 10 kHz allows us to use the resolution multiplier in the 1920A. Besides giving high resolution in a relatively short gatetime, the resolution multiplier has a second advantage. Its limited bandwidth (10 kHz) attenuates both the sum frequency from the mixer output ($f_1 + f_x$) and much of the system noise. This means that a low pass filter, which is normally required at the mixer output, is not needed here.

If all of the instruments are coupled to the inhouse primary frequency standard, only its accuracy, the noise of the mixer and the accuracy of the resolution multiplier (±2 counts) affect measurement accuracy. When the mixer is used with a sufficiently low noise level (like a ZAD 1H from Minicircuits Labs) and the input signal levels are high enough, the noise of the mixer can be ignored. Total accuracy is less then: ±Accuracy of house standard ±2 Counts.

The limitations of the system are:
- frequency range of the mixer
- min/max input levels to the mixer
- mixer conversion loss
- sensitivity of the counter

Further, the signal levels input to the mixer should be equal to within a few dB.

An experimental system was built up with two 6011A Fluke Signal Generators (one for the known and one for the unknown signal), a 1920A-06, and ZAD 1H mixer with all instruments driven by a Fluke 1953A-10, high stability oven oscillator. The input signals to the mixer were varied between −20 dBm and +10 dBm at frequencies between one and 10 MHz. The error was always within the ±2 count limit. The mixer noise with this or any equivalent mixer is well below threshold and does not contribute to the total accuracy.

APPLICATION 3-3

Calibrating Function Generators Using Period Average

An inexpensive function generator can be calibrated during maintenance or after repair with good accuracy using the period average mode of a counter. Connect the generator to the counter and select the period mode on the counter and the desired resolution. The built in accuracy of the crystal time base will give lab calibration to the generator no matter what price range the function generator falls into.

The function generator can then be used to test other equipment in the repair or maintenance shop.

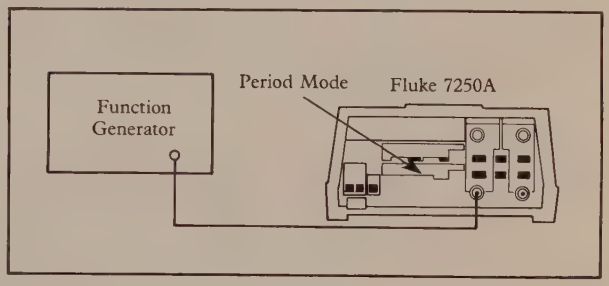


Figure 7.

Section 4
Totalize and A Gated By B Measurements

General Notes

Totalize is the simplest mode of a multifunction counter. In the totalize mode, the main gate is opened manually or by an external control signal. In this mode, the counter's time base is not used. Figure 8 shows the schematic in the totalize mode.

In the A gated by B mode, the A input is totalized during the time the B input is high. This is summarized in the diagram below, while the schematic for the A gated by B mode of the counter is shown in Figure 10.

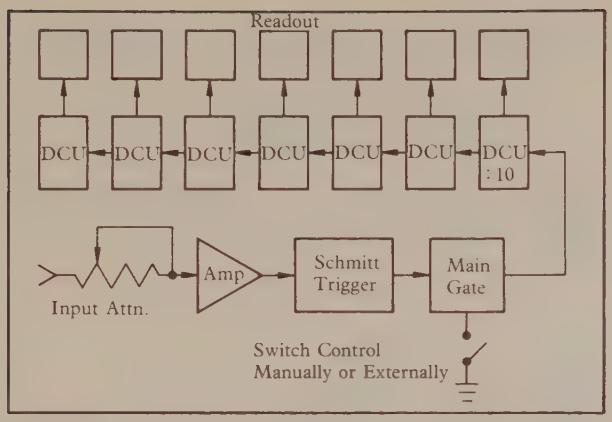


Figure 8. TOTALIZE MODE

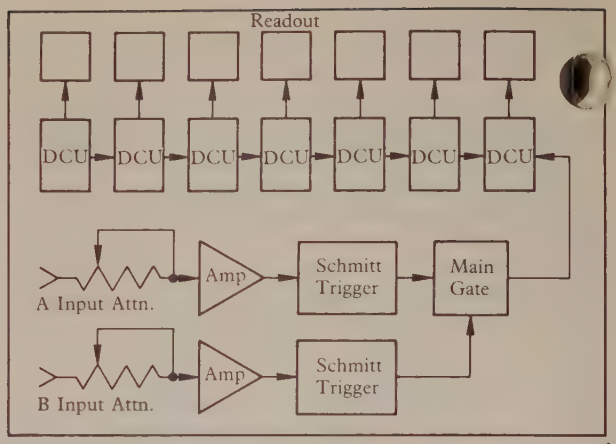


Figure 10. A GATED BY B

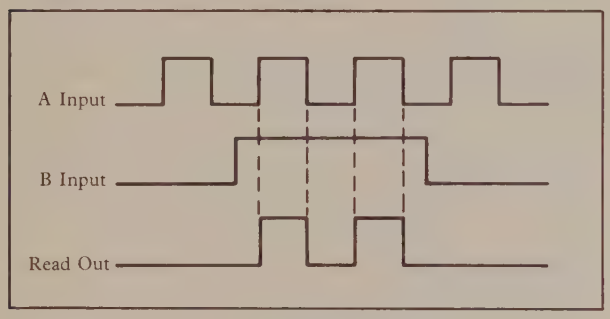


Figure 9. A GATED BY B READOUT

APPLICATION 4-1

Contact Bounce

When a relay or switch closes, its contacts will generally bounce a number of times due to the elasticity of materials used. Bouncing can be detected and the number of bounces counted, with the set-up in the diagram below.

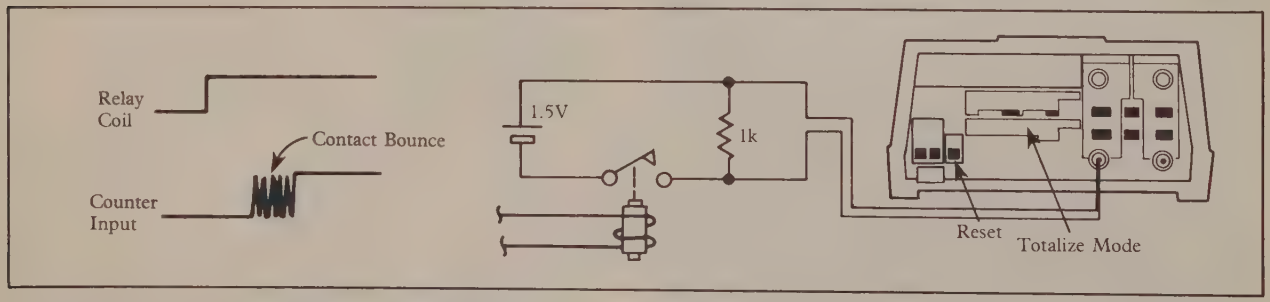


Figure 11.

When the relay (or switch) is closed, each contact bounce will be totalized on the counter.

APPLICATION 4-2

Counting the Number of Pulses in a Burst

When counting the number of pulses in a burst where the signal amplitude is very small or the modulating waveform is not available to trigger the counter, the set-up in Figure 12 is useful.

In this example, the oscilloscope vertical amplifier amplifies the signal amplitude and the B Gate Out signal provides a signal that can be used to control the measurement time of the 1953A in its A gated by B mode.

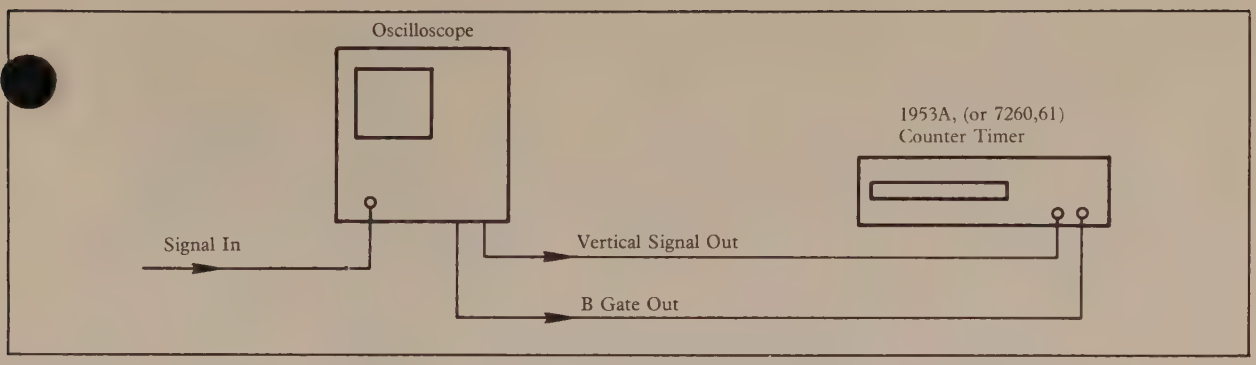


Figure 12.

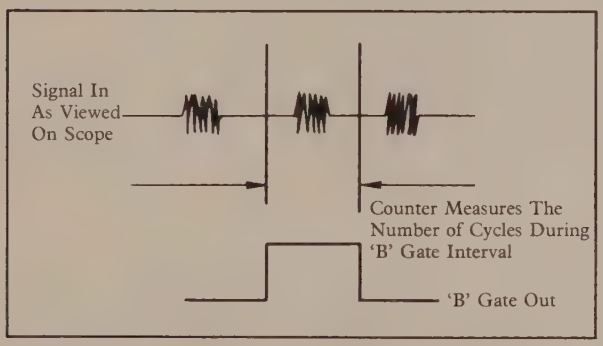


Figure 13.

[illegible]n oscilloscope with delayed sweep, the position and [illegible]ation of the "B Gate Out" pulse may be adjusted by the delayed sweep controls. To make this measurement, the delayed sweep controls are adjusted so that the intensified portion of the sweep exactly brackets one signal burst. In the example in Figure 13, The 1953A, in the 'A gated by B' mode, will totalize the number of cycles in the signal burst over the duration of the 'B gate out' pulse. If the bursts are repetitive and requirement is to totalize the number of pulses in a single burst, set the oscilloscope trigger mode switch to "single sweep". The scope will then put out a single B Gate Out cycle and the 1953A will totalize pulses in only a single burst.

APPLICATION 4-3

Elapsed Time Using Clock Out of 1925A or 1953A

Elapsed time may be measured using the above diagram, with the counter in the totalize mode. At the start of the event the switch is closed by the operator. The counter, [illegible]h as a 10 MHz timebase, will give a display of 10 000 [illegible] in one second of time, or 1.000 000 seconds. This is 10 ns resolution! If 12 seconds go by, your display will be 10 000 000 x 12 = 120 000 000, and if 60 seconds go by, your display will be 60 x 10 000 000 or 600 000 000.

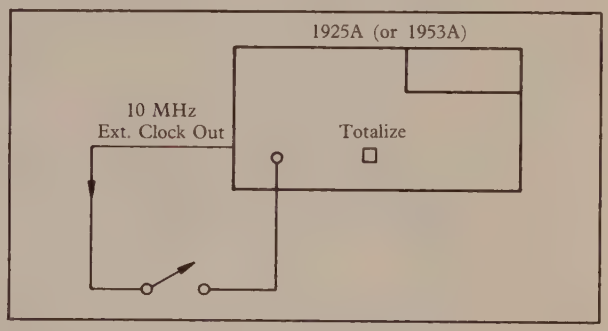


Figure 14.

If you wish to totalize electronically you may use a NAND gate connected in the diagram below.

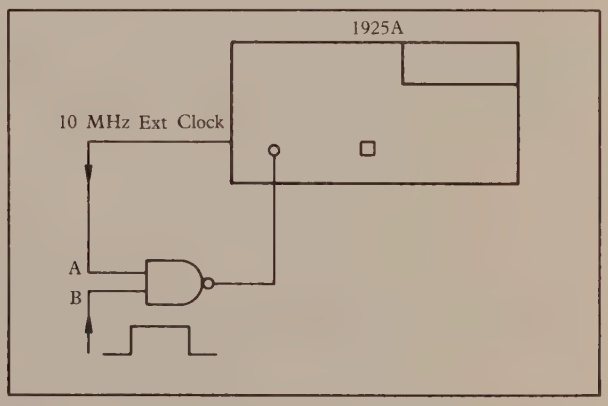


Figure 15.

APPLICATION 4-4

Elapsed Time Using Totalize

While the 10 ns resolution of application 4-3 is outstanding, it can be too much for some measurements. The solution to this is to reduce the frequency counted.

With an input frequency of 1 kHz, each pulse totalized represents an elapsed time of 1 millisecond. To read minutes, change input frequency to 1.6667 kHz, the display will read in milliminutes. These lower frequencies will fill the display more slowly.

If your only signal source is an inexpensive function generator, it should be set to frequency using the counter in its frequency mode.

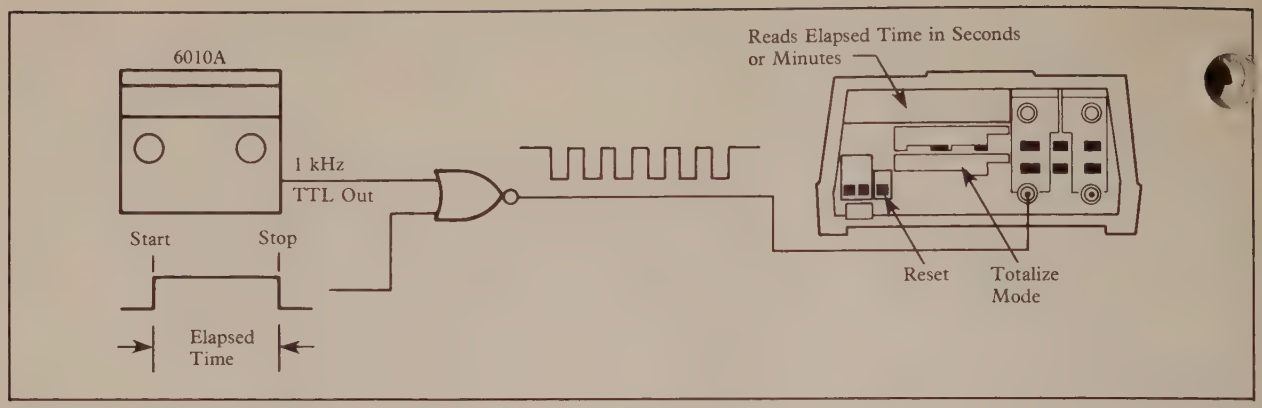


Figure 16. ELAPSED TIME USING TOTALIZE MODE

Section 5
Time Interval Measurements

General Notes

The time interval function is used to measure the time between two selected points on a waveform or the time between selected points on two separate waveforms. Time interval measurements require two separate input channels with separate circuitry for triggering levels, polarity and slope. Refer to Figure 17.

The main gate is opened by input A and closed by input B. During the time the main gate is open, the counter is counting its own internal oscillator.

The time interval mode is a most versatile and useful counter mode but it is not available on all counters because of the additional circuitry that is required is costly. Usually counters that offer time interval are referred to as Universal Counter Timers.

Some applications for time interval measurements include: delayed sweep calibration of scopes, digital circuit evaluation, and cable length measurements by pulse propagation time measurements.

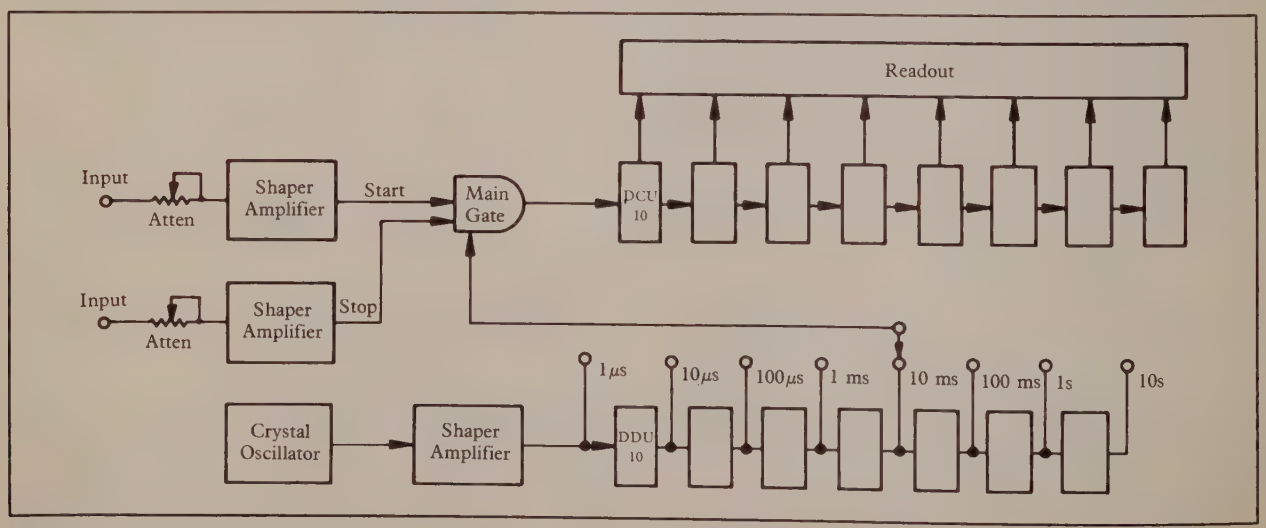


Figure 17. TIME INTERVAL

APPLICATION 5-1

Time Interval Using Scope B Gate

A delayed sweep oscilloscope and a 7250A Universal Counter Timer can be used together to measure the time duration of various parts of complex signals. The intensified portion of the trace is exactly positioned over

the signal to be measured. The time interval of the oscilloscope's "B Gate Out" as measured on the 7250A, will then [illegible] the duration of the complex signal.

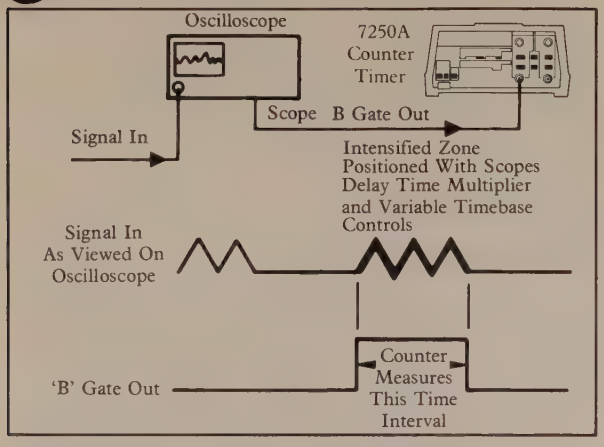


Figure 18.

APPLICATION 5-2

Time Delay Measurements with Scope Time Delay Multiplier

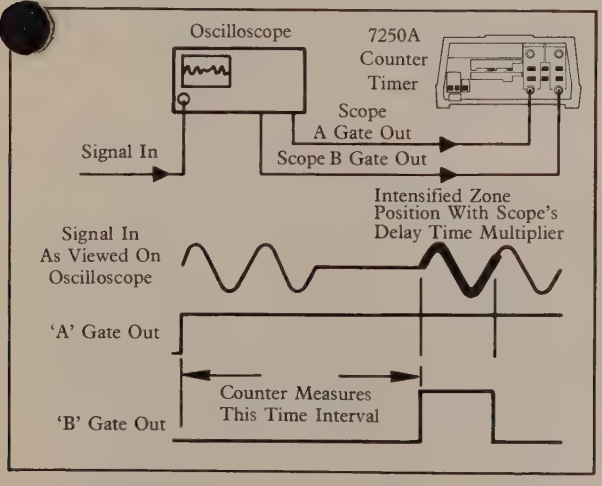


Figure 19.

The above diagram illustrates a technique to measure precisely the time from the beginning of an oscilloscope sweep time to any other point on the sweep. The technique requires an oscilloscope with "A Gate Out" and "B Gate Out" as well as delayed sweep. The counter, a Fluke 7250A, has 100 s resolution in the time interval mode.

[illegible]PLICATION 5-3

Using the Marker Output

To enhance trigger level setting accuracy for time interval measurements, use the marker output of the 7260A in conjunction with a dual trace oscilloscope. As the diagram shows, the signal displayed on the oscilloscope will represent the time interval being measured by the 7260A. You may change the trigger points by varying the trigger controls on the counter.

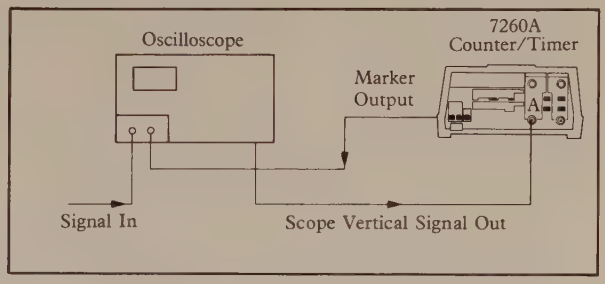


Figure 20. INTERCONNECTIONS FOR MARKER USE

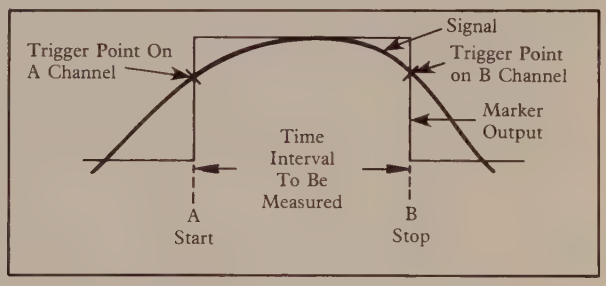


Figure 21. MARKER & SIGNAL

APPLICATION 5-4

Time Interval Using Dual Trace Scope In "Add" Position

A universal counter, when combined with a dual trace, delayed sweep oscilloscope, can precisely measure the period, width, or time interval between non-adjacent pulses of any waveform. An oscilloscope alone can perform these measurements, of course, but not with the accuracy of a counter. On the other hand, the counter input is "blind" and does not know which region of the waveform to measure. Uniting both instruments makes a superior measurement system.

For a scope to measure the period, width, or time interval between two given points of a specific waveform, the scope must isolate the interval of interest and so provide the gating necessary for counting. Thus a scope with a delayed sweep option is required.

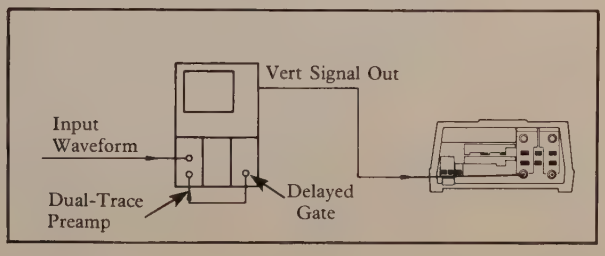


Figure 22.

Counter/Scope used to perform more types of measurements, more accurately, on waveforms than either instrument alone.

As shown in Figure 22 the delayed-gate output of the scope (whose pulse width and position are identical to the portion of the input waveform that's intensified) is connected to one of the vertical input channels and the waveform to be measured to the other. The scope is then placed in the input channels algebraic-add mode. With the scope's horizontal-mode switch in the intensified position, the portion of the waveform of interest is then selected with the delay-time multiplier control. The section of input waveform that the user has chosen to intensify will be elevated above ground potential (Figure 23). It is then a simple matter to adjust the counter's threshold control to trigger at a selected point on the elevated section of the waveform appearing at the scope's vertical signal output port.

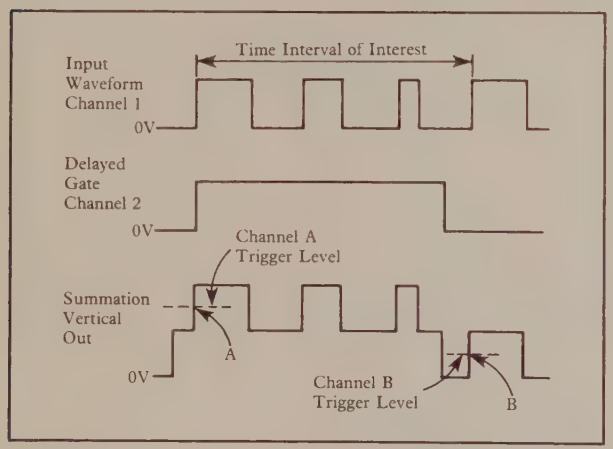


Figure 23.

Section 6
Ratio Measurements

General Notes

The ratio function is used to measure the frequency ratio of two input signals. One signal is coupled into Channel A, the other into Channel B, as in the diagram below.

Assume that the counter must measure the time between points A and B as shown in the above diagram. Place the counter in its time interval mode, and make sure that channel B of the counter will not trigger until channel A has done so. The threshold of each channel is set so that the rising edge of the elevated waveform triggers channel A of the counter, and channel B triggers after the elevated pulse has returned to its normal level. Thus the middle region of pulses contained in the elevated waveform will then be ignored by the counter.

APPLICATION 5-5

Time Interval Hold-Off

If you wish to measure the time of a contact from close to open, this may be made using a 7260A or 7261A counter. Without time interval hold-off, the time interval between A to B in the above diagram, would be measured. With T.I. hold-off, the initial bouncing can be ignored, and the time from A to D, or close to open, can then be measured.

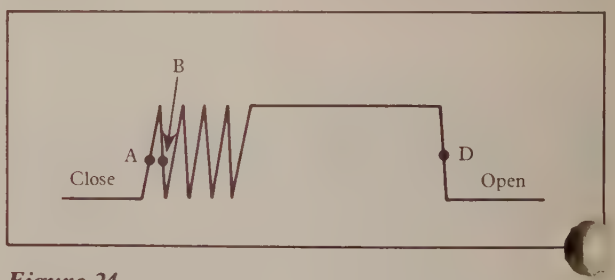


Figure 24.

Usually the higher frequency will be applied to the A input and the lower frequency to the B input. Ratio measurements are accomplished by using B input to open and close the main gate, and counting the A input. Example: if the two input frequencies were 1 MHz and 1 kHz, 1 kHz would be connected to the B input and the 1 MHz signal to the A input. The main gate would then be gated on for $\frac{1}{1000}$ s or 1 ms, during which 1000 pulses

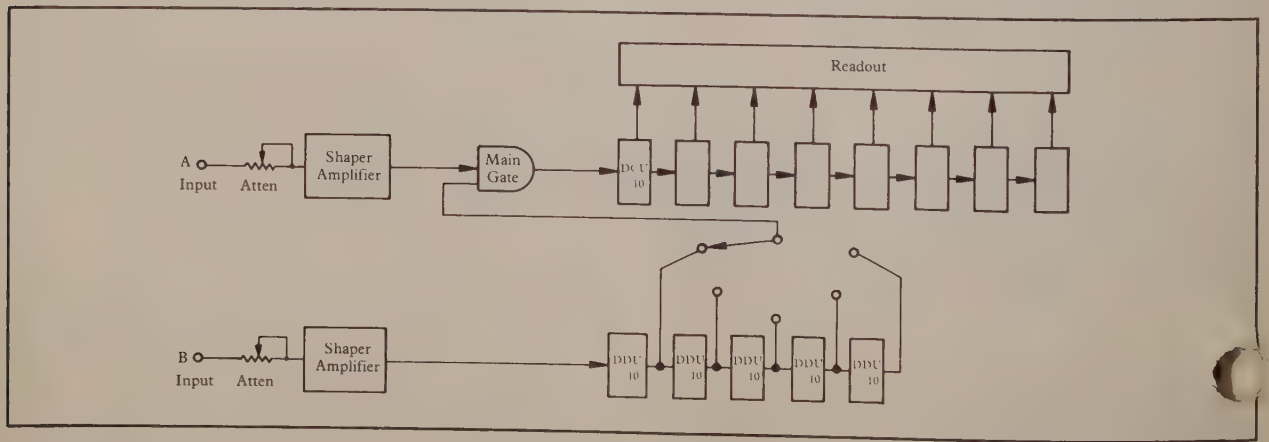


Figure 25. RATIO MODE

of 1 MHz would pass through the main gate. The readout would display 1000, which would indicate a ratio of [illegible] to 1.

APPLICATION 6-1

Ratio Mode for Checking ÷ N Dividers

Checking the frequency dividing function of programmable dividers (like the one in the phase locked loop circuit of Figure 25) is an easy job for the ratio function. To test the divider ratio, connect the divider-in signal to the A input of the counter and the divider-out signal to the B input of the counter. After selecting the ratio function the counter will then display the ratio of the two frequency. This will equal the actual division ratio.

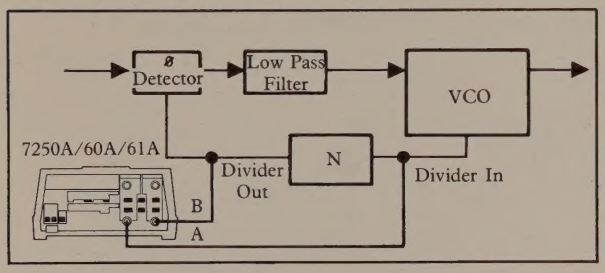


Figure 26.

APPLICATION 6-2

Frequency Ratio Using Ext Clock Input

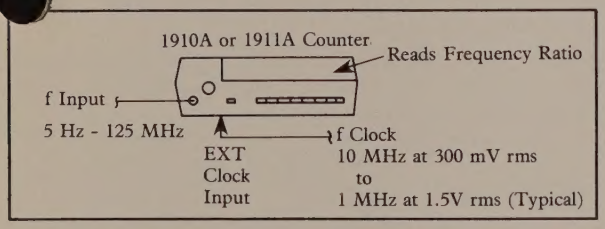

1910A or 1911A Counter
Reads Frequency Ratio
f Input
5 Hz - 125 MHz
f Clock
EXT Clock Input
10 MHz at 300 mV rms to 1 MHz at 1.5V rms (Typical)

Figure 27.

If your counter does not have a ratio function, the external clock input may be used to implement ratio. Put the input nearest to 10 MHz in the clock input and the other signal in at the front panel. Select the frequency function and read the display. The relationship between the two frequencies and the display is:

$$\text{Display} = \frac{\text{f input} \bullet 10\ \text{MHz}}{\text{f clock}}$$

Examples: 60

f input	f clock	Display	
60.0 Hz	1.0 MHz	.06000 kHz	.01 Hz
111.1 Hz	888.88 kHz	1.250 kHz	resolution!
2.2 MHz	7.0 MHz	3.1429 MHz	
123.45 kHz	6.54321 MHz	188.669 kHz	

[illegible] mode is often used to provide greater resolution than normally available in the frequency mode. In the first example the 1.0 MHz external clock expands the maximum gate time to 100 seconds providing .01 Hz resolution.

There are a few things to keep in mind with this application:

1) The external clock has only limited bandwidth, perhaps 10 MHz ± 1 MHz. For our example the clock input is 10 MHz ± 1 MHz and − 9 MHz.
2) The external clock input usually needs TTL levels to work properly and keep measurement errors for a minimum.

Section 7
Industrial Applications

APPLICATION 7-1

Measuring RPM

Use the direct input and select FREQ mode with 1 Hz resolution (1 second gate time). 60 pulses per revolution will make the counter read directly in RPM with correct decimal. The 60 tooth wheel and transducer combination can be purchased from Dynapar Corp., Gurnee, IL 60031. NOTE: Magnetic transducer pulses are sometimes noisy. Use the Attenuator and Trigger Level Control to minimize this problem, and if necessary use a low-pass filter such as the Y7201 on the 1 KHz range.

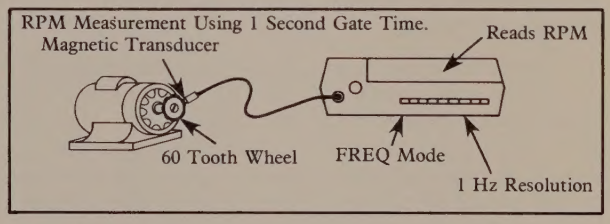


Figure 28.

APPLICATION 7-2

Scaled Readout Using Variable Ext Clock Input

Using a variable timebase for the EXT CLOCK input, the counter display can be made to read out directly in industrial units of feet/min, gallons/hrs, etc. In the below example, the counter is providing a direct readout of surface velocity of the conveyor belt. *The external clock frequency is calculated as follows:*

$$\text{Velocity} = V = 2\pi r \bullet \text{rpm} \quad \text{(feet/min)} \quad (2)$$

where r = drive pulley radius in feet

$$\text{f input} = \frac{\text{rpm}}{60} \bullet N\ \text{(Hz)} \quad (3)$$

If we let Display = Velocity and substitute equations (2) and (3) into equation (1) from Application Note 6-3 (1), the result is:

$$\text{f clock} \quad \frac{N}{120\pi r}\ \text{(MHZ)} \quad (4)$$

Example:

N = 100, rpm = 60, r = 1 ft

Velocity = (2π) (1) (60)

= 376.99 ft/min

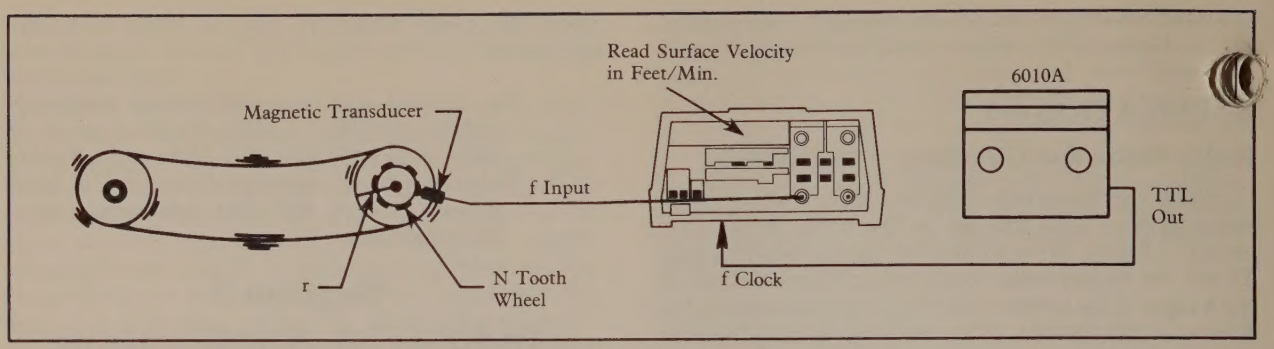


Figure 29.

The counter will read .377 kHz (kilo feet/min) if the external clock frequency is 2.65257 MHz. This frequency is calculated using equation (4) as follows:

$$f\ clock = \frac{(100)}{(12)\ (3.1416)\ (1)}\ MHz$$

$$= 2.65257\ MHz$$

APPLICATION 7-3

Measuring Frequency Using 80I-600 Current Probe

The clamp on probe is a good way to measure frequencies on a large voltage signal. This method not only isolates the counter from the high voltage but also attenuates noise commonly found on high voltage signals. Connect as in the diagram below with a resistor to give an input voltage to the counter within its sensitivity range. You can then read out the frequency on the counter.

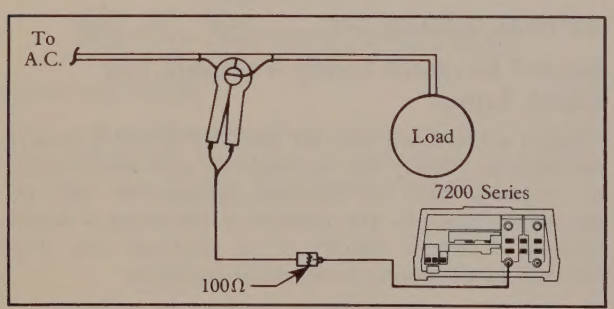


Figure 30.

APPLICATION 7-4
Measuring RPM With 7250/60/61A

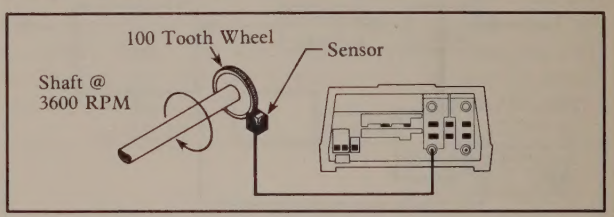


Figure 31.

RPM measurements can be made on a 100 tooth wheel easily using a 7250, 60, or 61A counter.

If a shaft is turning at 3600 RPM, as in the diagram above, with a 100 tooth wheel, the sensor output is 360,000 pulses/min. Dividing this by 60 to get pulses/sec = 6000 pulses/sec.

You may prove the counter reading by feeding in 6 kHz and then place the function slider in the CPM mode — the counter will read 3600.

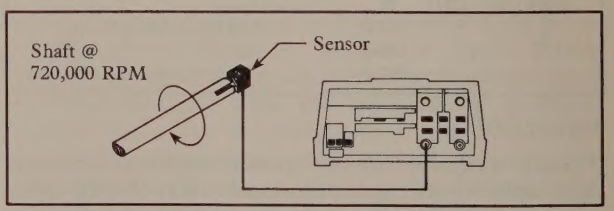


Figure 32.

The sensor output will be 720,000 pulses/min, dividing this by 60 = 12,000 pulses/sec. If you put 12 kHz input to the counter in the CPMx100A mode, it will display 7200 (not 720,000). This is because this mode is set up to work in conjunction with the 100 tooth wheel in Figure 31.

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